ABSTRACT

Title of dissertation: ESSAYS ON
PREFERENTIAL TRADE AGREEMENTS

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Doctor of Philosophy, 2019

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Preferential Trade Agreements (PTAs) are a prominent feature of current globalization. Over the last decades, country participation in PTAs has become widespread, with each member of the World Trade Organization having signed an average of 10 PTAs, up from 3 PTAs in 1990. Most importantly, the proliferation of PTAs was accompanied by a significant deepening of their scope. Their content now spans diverse behind-the-border disciplines, such as investment, technical barriers to trade (TBT), sanitary and phytosanitary (SPS) measures , intellectual property rights, visa and asylum, labor market laws and environmental regulations.

In order to quantify the impacts of the provisions included in PTAs on various outcomes of interest, such as gross trade, foreign direct investment (FDI), global value chains, quality, and so on, trade economists face several empirical obstacles to model Non-Tariff Measures (NTMs). While it is straightforward to model provision, such as an import quota or an export tax with an ad-valorem tariff equivalent, this technique is not suitable for other provisions that do not purely deal with market

access. Many NTMs are implemented to address behind-the-border issues rather than to discriminate against foreign businesses. Therefore, it would be misleading to restrict the effect of certain trade policies to their market access dimension only. The objective of this dissertation is two-fold: it is, first, to understand the impacts of the overall content of PTAs on economic outcomes and, second, to shed light on the relationships of specific disciplines included in PTAs with those outcomes.

In the first chapter, I review the recent evolution of trade and investment integration and how the content of PTAs has been reshaped over the years. The second and third chapters are dedicated to the analysis of two of the most frequent provisions in PTAs — TBT and SPS provisions. In the theoretical part, I augment the structure of the traditional Melitz model to assess the impact on quality of such provisions. I model TBT/SPS measures as domestic regulations ensuring minimum quality of goods. By integrating these regulations, PTAs change the economic structure of the model (with respect to minimum quality enforcement) from segmented to joint markets. I highlight two potential channels to explain the change in quality of exported goods following the enforcement of a PTA with TBT/SPS provisions. The first channel for quality improvement is driven by the increase in market size. With larger markets to export to, firms have the incentive to differentiate vertically their products in order to capture bigger shares. The second channel depends on the type of provisions implemented. I consider two cases, mutual recognition versus harmonization of TBT/SPS measures. The ultimate impact on quality of this regulatory channel depends on the new reference for minimum quality once a PTA is signed. Then, I empirically test the importance of these two channels using new

data on the content of PTAs and estimates of the quality of imported goods. I find that mutual recognition positively impacts quality relatively more than harmonization. This result is driven by PTAs between developed and developing countries. The effect is heterogenous across sectors, with bigger impact of deep PTAs on goods that have a wider scope for quality differentiation. Finally, I study the impact of PTAs on FDI and find that deep PTAs promote foreign investments. The impact is bigger for projects related to service activities, as well as North-South investment relationships.

ESSAYS ON
PREFERENTIAL TRADE AGREEMENTS

by

Edith Laget

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2019

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Dedication

A Hélène

Acknowledgments

I am indebted to my advisor, Professor Nuno Limão, for his constant guidance and support, and for his enormous patience throughout this long process. I am thankful to Professor John Shea, Professor Eunhee Lee, Professor Felipe Saffie, and Professor Lars Olson for giving me valuable feedbacks and kindly agreeing to serve in my dissertation committee.

I would like to thank all my friends from the current and past trade groups Lerong Li, Alejandro Graziano, Karam Jo, Heehyun Lim, Marisol Rodriguez Chatruc, Yang Xu and Jingting Fan, who were always keen to discuss ideas and helped me solve issues with my research. I also thank Professor Basile Grassi for his friendship and support, from our first days at the ENSAE until the final review of this dissertation.

I owe a great deal of gratitude to my colleagues at the World Bank Nadia Rocha, Michele Ruta and Gonzalo Varela for their trust, practical advices and incredible mentoring.

None of this would have been possible without the constant emotional support of my entire family, in particular my parents Catherine and Michel Laget and my brother Etienne. I have no word to describe how deeply grateful I am to my husband Antoine for accompanying and supporting me in the most perfect way throughout this difficult journey.

Most importantly, thank you my little Hélène for giving me the last piece of motivation to finish my thesis.

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List of Abbreviations

BACI	Base d'Analyse du Commerce International
CEPII	Centre détudes prospectives et d?informations internationales
CES	Constant Elasticity of Substitution
CFI	cost, insurance and freight
EMA	European Medicine Agency
EU	European Union
FDA	Food Drug Administration
FDI	Foreign Direct Investment
FOB	free on board
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GVC	Global Value Chain
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
MFN	Most Favored Nation
MRA	Mutual Recognition Agreement
NAFTA	North American Free Trade Agreement
NTB	Non-Tariff Barrier
NTM	Non-Tariff Measure
PTA	Preferential Trade Agreement
SPS	Sanitary and Phytosanitary
STC	Specific Trade Concerns
TBT	Technical Barriers to Trade
TPP	Trans-Pacific Partnership
TRAINS	Trade Analysis Information System
TRIPS	Trade-Related Aspects of Intellectual Property Rights
TTIP	Transatlantic Trade and Investment Partnership
UNCTAD	United Nations Conference on Trade and Development
US	United States
USD	US dollar
USTR	United States Trade Representative
WIOD	World Input-Output Database
WTO	World Trade Organization

Chapter 1: Introduction to modern Preferential Trade Agreements

1.1 Evolution of trade integration

Trade has arguably been the most important driver of economic growth for both advanced and developing economies in the second half of the 20^{th} century. Economists agree on the long term benefits of trade, based on empirical evidence pointing out that economies more open to trade tend to show stronger growth and development performance. After a long period of import substitution industrialization, developing economies that eventually shifted from protectionist to export-led growth strategies recovered faster from the early 1980s global economic recession. The early 1990s represented a tipping point for globalization, as an increasing number of countries embraced market-economy systems as well as global trade and investment integration.

The positive relationship between trade and economic growth has long-been established in the trade literature. Trade openness generates economic gains by leveraging comparative advantage and enabling a more efficient exploitation of production factors. Because it enhances competition and economic diversification, trade can also a channel for increased productivity, positive knowledge spillover, and better resilience to external shocks. For all these reasons, the quest for the gains from

trade has pushed governments seeking deeper international integration to reduce the overall level of trade restrictions, which they have accomplished at both the multilateral and regional levels.

Since the creation of the General Agreement on Tariffs and Trade (GATT) in 1947, member countries have engaged in several rounds of multilateral negotiations to increase market access. Over the years, the negotiations have welcomed more countries and supported more ambitious reforms. The desire to adjust international trade rules to a far more complex policy environment and to deepen multilateral commitments ultimately led to the foundation of the World Trade Organization (WTO) in 1995. As part of the Uruguay Round agenda and subsequent ministerial conferences, WTO member countries continuously extended market access and negotiated policies in areas such as trade in services, rules of origin, dispute settlement or temporary trade remedies (safeguards, countervailing duties, and temporary export restraints), and also introduced non-trade related policies dealing with beyond market access issues such as intellectual property and domestic regulations on non-tariff measures (NTMs). Broadly defined, NTMs are "policies other than custom tariffs that can potentially have an adverse effect on trade in goods and services, changing quantities traded, or prices or both."[1] Table (1.1) shows the UNCTAD classification of NTMs in terms of scope and design. NTMs vary by their mode of application, and consist of technical, non-technical or export-specific measures.

[1]As noted by the International Trade Center (ITC) "NTM is a neutral concept and does not necessarily imply a particular direction of impact. It is not synonymous with the frequently used term, non-tariff barrier (NTB), which implies a negative impact on trade. NTBs may be view as a subset of NTMs that have a protectionist or discriminatory intent." (see: https://ntmsurvey.intracen.org/support-materials/understanding-ntms)

NTMs are by far more complicated to interpret than traditional trade policies such as customs tariffs. Their classification requires in depth knowledge of the legal terminology used in the regulatory texts establishing them. The ways countries have addressed the surge in such measures to mitigate their impact on trade is at the center of my dissertation and I will discuss this issue more in the subsequent sections of the present introductory chapter.

Despite the common and persistent interest in reducing trade barriers in their multiple forms (traditional customs tariffs and NTMs with adverse effects on trade), progress on trade integration within the WTO's multilateral framework has stalled since the last round of negotiations that began in Doha in 2001. The reform of agricultural subsidies, among other proposed rules, is one of the most contentious reasons for this round's failure. [2] The conflicting positions associated with the WTO's consensus based decision-making process has prevented its current 164 members from reaching an agreement so far. Arguably, this lack of progress at the global level has led many member states to look for faster regional or bilateral integration solutions, resulting in a proliferation of Preferential Trade Agreements (PTAs).

From early on, regional integration has coexisted with multilateral integration through first the GATT and then the WTO. Under the GATT's Article XXIV, signatories are allowed to grant special treatment to one another by establishing regional agreements, provided that they substantiality eliminate duties and other barriers on all trade in the region (disapproving partial agreements on a limited

[2] In short, developed member states led by the European Union (EU) and the United States (US), have refused to lower their domestic subsidies on agriculture, in exchange of increased market access granted by their developing counterparts.

number of goods), and that outside countries do not face higher barriers than before the establishment of the regional agreements. The Treaty of Rome, establishing the European Economic Community, which was signed in 1957 and entered into force in 1958, was the first regional trade agreement notified to the GATT under its Article XXIV. The 1994 North American Free Trade Agreement (NAFTA) was the second major such regional trade agreements to be notified to the GATT.

From the 1950s to the 1990s, the number of PTAs increased continuously to almost 70. It was around the time of NAFTA's creation that regional integration really boomed in terms of membership and scope of commitments. PTA creation rapidly accelerated to reach close to 300 agreements currently in force. New data on the content of PTAs compiled by the World Bank[3] shows that more than 40 percent of agreements include "deeper" provisions tackling issues, such as anti-dumping and countervailing measures, rules on competition, investment, movement of capital, intellectual property rights, and TBT and SPS measures. Other areas, such as labor market and environmental regulations, visa and asylum rule are also included in at least 20 percent of active agreements.[4] The data also shows that agreements signed prior to the WTO include on average 9 policy areas, whereas the most recent ones cover more than 15 different policy areas. Figures (1.1) to (1.5) display this evolution of PTAs in terms of scope and depth.

The prevalence of PTAs and the deepening of their commitments has spurred a

[3]World Bank's Content of PTAs database available at: https://datacatalog.worldbank.org/dataset/content-deep-trade-agreements. More on this data in the next sections.

[4]See tables A.1 and A.2 for the full lists of provisions included in trade agreements, and further comments on the data in the subsequent section of this introductory chapter.

lot of interest in trade policy research. In his chapter of the Handbook on Commercial Policy dedicated to PTAs [Limão, 2016], Limão organizes this research around two basic questions: "What explains the formation and proliferation of so many PTAs and what are their basic trade and welfare effects on members?" He demonstrates that conventional tools are inadequate to address these two questions when it comes to modern PTAs, and therefore calls for careful revisions of traditional models of PTAs. Specifically, the estimated effects of PTAs obtained from the standard gravity approach raise two puzzles. The first one is the PTA formation puzzle — if PTAs are expected to grant market access to the signatories, then why are so many PTAs signed despite their heterogenous and sometimes small trade effects that are commonly estimated in the literature? The second puzzle concerns PTA's trade elasticity. This puzzle emerges after correcting the statistical issues that led to the first puzzle — long-run (corrected) estimates of PTA effects on trade volumes are actually too large to be explained by the observed reduction of trade barriers given reasonable estimates of trade elasticities. In light of these two puzzles, reducing modern PTAs to their effect on preferential tariffs would be a mistake, as it would overlook their impact on behind-the-border barriers. Limão therefore recommends that scholars carefully "augment the economic and policy structure of traditional models of PTAs."

From the negotiations of the defunct Transatlantic Trade and Investment Partnership (TTIP) between the US and the EU, to the newly signed EU-Mercosur trade agreement, modern PTAs tend to animate the public debate for the mere reason that it is complicated to predict their economic impact. Proponents claim that in-

creased business opportunities would lower prices and create jobs, while opponents fear that the agreement would lower the capacity of local governments to regulate industries and give too much power to transnational corporations. Moreover, negotiations of such so-called "mega trade deals" are not happening in the most favorable environment. The world economy is slowly recovering from the Great Recession but with lingering effects on trade and FDI flows and voters' confidence. Within the last decade, a backlash against globalization has gained momentum and has been exploited by populist political movements, which ultimately found their way into several newly-elected governments. In this context, trade economists' role to provide unbiased evidence on the effects of trade and investment integration is more important than ever.

This thesis aims to contribute to restoring faith in the potential of rule-based international economic integration. It follows the recommendations stated in [Limão, 2016] by improving traditional models of PTAs and incorporating specificities of modern agreements in order to grasp their full impact on various outcomes of interest. Throughout the text, I will use interchangeably the terms "modern" or "deep" PTAs to qualify those agreements that address behind-the-border measures. In the first part of my dissertation, I study one of the most common policies included in PTAs, namely TBT and SPS provisions.

In the following two chapters, I explain how I modify the traditional [Melitz, 2003] heterogenous firms model to account for the effects of TBT and SPS measures on firms' decisions to produce and export. Specifically, I incorporate a quality choice mechanism that enables me to quantify the impact of TBT and SPS provisions

in PTAs on the average quality of exported goods. I show how such provisions change the market structure of standard models of PTAs by modifying the way firms optimally choose quality, from separable to joint decisions. Models of modern PTA can help explore their impact on various key outcomes, such as trade, global value chains (GVC) integration, and foreign direct investment (FDI). The last chapter of this dissertation focuses on the impact of deep agreements on FDI.

1.2 The rise of non-tariff measures

Before going into the details of the analysis of modern PTAs, it is worth giving an overview of the closely related subject of NTMs. As custom tariffs were progressively reduced under the WTO and PTAs, policy makers and private sector stakeholders have become increasingly concerned by the rise of these multiple and often less transparent obstacles to trade. As mentioned above, NTM is a broad term referring to any measure other than tariffs, which alters (purposely or not) the competitiveness of foreign goods. These measures comprise a large array of instruments, such as quantitative restrictions, TBT and SPS measures, pre-shipment inspections, etc. The WTO dedicated a whole report to this topic a few years ago [WTO, 2012] shedding light on how NTMs are becoming a major source of trade costs.

Because of their complex nature, there is not a unified approach for identifying the magnitude of NTMs and assessing their effects on international trade. One way to do this is to compute their ad valorem equivalents. [Kee et al., 2008] and [Kee

et al., 2009] develop indicators to compare the relative effects of tariffs and NTMs. They estimate ad valorem equivalents of NTMs, and use them to compute an Overall Trade Restrictiveness Index. Building on the original work of [Anderson and Neary, 1994], they show that NTM's effects are on average equivalent to a 12 percent applied tariff, which increases the restrictiveness already imposed by traditional trade barriers by 87 percent.

A more basic measure relies on a frequency index that accounts only for the presence or absence of an NTM in a country. Figure (1.6) displays the aggregated number of NTMs recorded in the UNCTAD TRAINS database. This NTM dataset covers more than 55.000 measures implemented in 109 countries. Since countries are not required to declare their use of NTMs, data collection is a resource-intensive task conducted by legal experts, who review legal documents, regulations, directives, rules and the like in the most comprehensive and comparable possible fashion. The figure shows that SPS and TBT are by far the most commonly used behind-the-border measures. For the sake of health and safety, governments are allowed to implement non-discriminatory quality standards, technical regulations, risk assessments and the like, on any goods available in their market. This is stated in the WTO's TBT and SPS Agreements that entered into force with the WTO's establishment in 1995. These agreements recognize the right of each member country "to take measures necessary to pursue national security, to prevent deceptive practices or to protect human health or safety, animal or plant life, or health or the environment." They also require that any such TBT/SPS measure be as non-disruptive as possible for trade.

Yet, the frontier between legitimate policy objectives and protectionist motives is often blurry. TBT/SPS measures can impose disproportionate costs on foreign producers or create an unfair disadvantage for foreign competitors. Although these measures should not be protectionist in nature, and should not apply differently to foreign and domestic producers, they often result in increasing costs for exporters which must comply with additional regulations. This is particularly burdensome for developing countries' exporters, who might lack the capacity to comply with such measures because of inadequate production and/or certification processes. On the other hand, there is evidence that developing countries have increased their use of TBT/SPS measures at least as much as developed countries. Figure (1.7) shows the evolution of TBT and SPS Specific Trade Concerns raised to the WTO against developed, developing and least developed countries.

TBT/SPS-related NTMs can take endless forms. The annual National Trade Estimate Report on Foreign Trade Barriers prepared by the Office of the United States Trade Representative (USTR) provides concrete examples of TBT/SPS practices and estimates of their trade costs whenever possible. The report is a comprehensive survey discussing the state of major trade barriers (of any type) currently faced by the US (and others) stakeholders in the largest export markets (61 countries, plus the European Union, Taiwan, Hong Kong, and the Arab League). For example the 2019 National Trade Estimate Report[5] indicates that India imposes security and safety requirements for telecommunication equipment. This TBT measure is described as follows: "The Compulsory Registration Order prescribes safety

[5]https://ustr.gov/sites/default/files/2019_National_Trade_Estimate_Report.pdf

standards and in-country testing requirements for electronic and information and communications technology goods. The policy, which entered into force in January 2014, mandates that manufacturers register their products and have them certified by laboratories accredited by the Bureau of Indian Standards (BIS), even if the products have already been certified by accredited international laboratories. [...] U.S. stakeholders have raised concerns regarding delays in product registration due to the lack of government testing capacity, a cumbersome registration process, canceled registrations for administrative reasons unrelated to safety, and additional compliance costs that can exceed tens of millions of dollars, including costs associated with factory-level and component-level testing." An example of an SPS barrier is discussed regarding South Korea's rules for beef and beef products: "Prior to 2008, Korea restricted the importation of U.S. beef and beef products, citing bovine spongiform encephalopathy (BSE)-related concerns. In 2008, the United States and Korea reached a bilateral agreement to fully reopen Korea's market to U.S. beef and beef products. However, as a transitional measure, U.S. beef and beef products imported into Korea must be derived from animals less than 30 months of age."

A growing strand of the literature analyzes the impacts on trade of the surge of NTMs. Some studies have investigated the use of NTMs in place of low import tariffs for protectionist purposes and showed that the shares of trade covered by NTMs have dramatically increased since the financial crisis. [Bown and Crowley, 2013a, Bown and Crowley, 2013b, Bown and Crowley, 2014] use data on temporary trade barriers to show that their increasing use is correlated with countries' commitment to multilateral tariff discipline.

Statistical and quantitative evidence associated with surveys like the USTR's shows that SPS and TBT measures have a high potential for trade diversion for those exporters that might not be able to comply with the safety standards. Through the WTO and PTAs, policy makers have worked to find a compromise between maintaining the legitimate objectives of SPS and TBT measures and reducing the trade costs they generate. As argued, by opponents of the TTIP, increased market access should not come at the expense of product quality, consumers, animal or environment safety.

1.3 Content of modern PTAs

As mentioned above, most of the 294 PTAs currently in force and notified to the WTO have been signed within the last three decades, a period during which the number of agreements has multiplied five-fold. The most dramatic reforms in terms of trade policy emerged in the mid-90s when countries started to include provisions lying outside the WTO's mandate with the objective to tackle the rapid increase in NTMs.

In this thesis, I use a new dataset on the content of PTAs developed by the World Bank. Its first version[6], released in 2016, maps the content of all 279 PTAs that are in force and notified to the WTO as of 2015. The mapping methodology is based on the work of [Horn et al., 2010], which was also used in the World Trade Report 2011 [WTO, 2011]. Specifically [Horn et al., 2010] identified a comprehensive set of 52 "disciplines" (or policy areas) in 14 EU and 14 US PTAs notified to

[6]denoted 1.0 throughout the text

the WTO as of 2008.[7] As noted by [Horn et al., 2010], "the classification is largely based in the articles headings in the case of the EU agreements, and on the chapters headings in the case of the US agreements". The World Bank extended the PTA coverage to all agreements in force and notified to the WTO, but keeping the original mapping across 52 disciplines.[8] Each discipline is classified based on its connection to the WTO mandate. The first category, denoted WTO-plus, corresponds to the 14 disciplines that fall under the current mandate of the WTO and are already subject to some form of commitment in its agreements, such as tariffs, anti-dumping, TBT and SPS. The second category, denoted WTO-extra, groups the other 38 disciplines that are outside the current mandate of the WTO, such as investment and competition policy. Table (A.1) lists the 14 WTO-plus disciplines and table (A.2) the 38 WTO-X. On top of the area coverage, the data provide information on the legal enforcement of each discipline within an agreement. The enforcement coding is based on the analysis of the legal language of the treaty text and the possibility of recourse to dispute settlement. All my empirical applications and content-related measures are based on the identification of legally enforceable disciplines. A discipline is considered legally enforceable "if the language used is sufficiently precise and committing (use of shall instead of should) and if it has not been excluded from dispute settlement procedures under the PTA." This first version of the dataset refers

[7]The 14 EU agreements are: EEA, EC-Turkey, EC-Tunisia, EC-Israel, EC-Morocco, EC-Jordan, EC-South Africa, EC-Mexico, EC-FYRoM, EC-Egypt, EC-Croatia, EC-Chile, EC-Albania, CARIFORUM, and the 14 US agreements are: US-Israel, NAFTA, US-Jordan, US-Singapore, US-Chile, US-Australia, US-Morocco, CAFTA-DR, US-Bahrain, US-Oman, US-Peru, US-Colombia, US-Panama, US-South Korea.

[8] [Hofmann et al., 2017] provide a thorough description of the database and the way the mapping of PTAs was implemented.

to the "horizontal" mapping of PTAs. By giving the breadth of a PTA, the data corresponds to the first dimension of an ambitious analytical research agenda aiming at screening the whole content of PTAs. Apart from their legal enforceability, disciplines are not differentiated with one another across agreements. Nevertheless, the horizontal breadth provides a rich source of information that enables me to model the scope of a PTA more precisely than the usual dummy variables that have been used in the literature so far.[9]

In a second round of efforts aiming at complementing the current knowledge of PTAs, the Content database has recently been extended to its vertical dimension. As part of my work in the World Bank's Global Trade Unit, I got access to this most recent and comprehensive mapping of PTAs to date before its release. The vertical mapping in the Content database 2.0 provides further information on a subset of 18 policy areas based on their economic importance and their frequency of occurrence in PTAs. On average 40 questions, or provisions to use the terminology employed by the World Bank, were identified by legal experts to characterize each policy areas. A guideline was provided to the experts in order to maintain a harmonized vertical mapping across policy areas. Whenever applicable, the provisions coded were sorted under pre-defined categories, such as scope and definition, sectoral application, transparency, substantial commitments, and exceptions. Experts were also required to assess the level of enforceability of the provisions, based on the legal language used in the chapters or the existence of a dispute settlement mecha-

[9]The Design of Trade Agreements Database (DESTA) is another source of information on the content of PTAs. It covers only 7 provisions, but extends the mapping to 620 agreements (including partial free trade agreements). This greater number of agreements does not match the usual PTA dummies used in the literature, which are often based on the list of PTAs notified to the WTO.

nism. As a result of this second mapping, the increased granularity of the Content of PTAs' database expanded the number of variables from 52 to more than 1000.

1.4 Thesis overview

This introductory chapter has given an overview of the topics that have motivated my research. While emphasizing the complementarity between the multilateral trading system and PTAs, I showed the stakes and challenges to properly deal with NTMs in empirical analysis. The rest of my dissertation is organized as follows:

In the next chapter, I lay out an augmented version of the [Melitz, 2003] model with endogenous fixed effects and quality choice. TBT and SPS measures are modeled as minimum quality requirement mechanisms that bring information to the consumers. This model enables me to draw predictions regarding the impact on quality of the presence of TBT and SPS provisions in trade agreements. I highlight two channels for quality improvement in the context of trade liberalization. On the one hand, firms might be inclined to vertically differentiate, meaning to increase the quality of their exports, to capture bigger shares following market enlargement. On the other hand, changes in TBT/SPS-related regulations may also have a direct impact on quality by changing minimum quality requirements.

The third chapter tests the importance of the two channels with an empirical exercise relying on an estimated measure of imported good quality. I follow closely the literature [Khandelwal, 2010] to obtain quality estimates for bilateral trade

flows. I then use the second version of the Content of PTA dataset described in the previous section to test which TBT/SPS provisions have the most significant impact on the quality of traded goods. I study potential sources of heterogeneity in those impacts, by integration approach mutual recognition versus harmonization, by level of development of the signatories, and by sector. I find that mutual recognition positively impacts quality relatively more than harmonization. This result is driven by PTAs between developed and developing countries. Deep PTAs have bigger impact on goods that have a wider scope for quality differentiation.

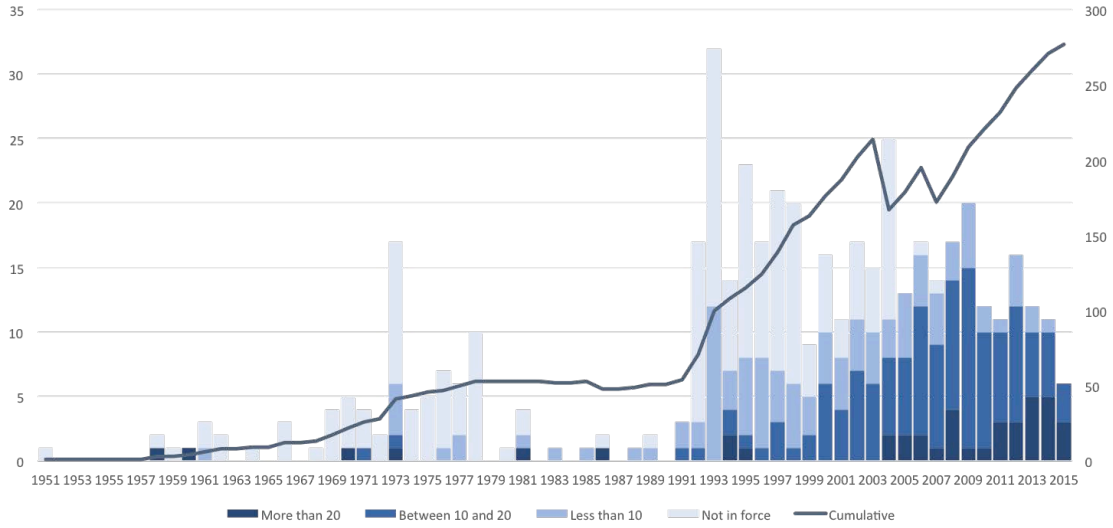
The fourth chapter presents research that I have conducted at the World Bank in collaboration with Nadia Rocha and Gonzalo Varela.[10] It is part of a wider research agenda aiming at understanding the impact of the content of PTAs on various economic outcomes.[11] Our work focuses on a set of investment-related provisions and shows how their contributions to FDI vary across sectors and level of development. We find that deep PTAs promote foreign investments. The impact is bigger for projects related to service activities, as well as North-South investment relationships.

Finally, chapter 5 concludes and offers suggestions for future work.

[10]The usual disclaimer applies for this collaborative work: this chapter has not undergone the review accorded to official World Bank publications. The findings, interpretations, and conclusions expressed herein are those of the authors and do not necessarily reflect the views of the World Bank Group and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

[11]Others have shown how the content dataset can be used to reveal differences in effects between shallow and deep PTAs. [Mattoo et al., 2017] show that deeper agreement (with more provisions) promote trade in aggregate terms with limited diversion. The authors argue that deeper agreements can actually have a positive spillover effect on trade with third countries if their design and implementation are non-discriminatory. Deep trade agreements are also expected to facilitate vertical FDI [Osnago et al., 2015], and to ease operations along GVCs [Laget et al., 2018].

1.5 Figures



Source: Author's calculation based on the World Bank's Content of PTAs database version 1.0.

Figure 1.1: Evolution of the number and number of provisions of PTAs

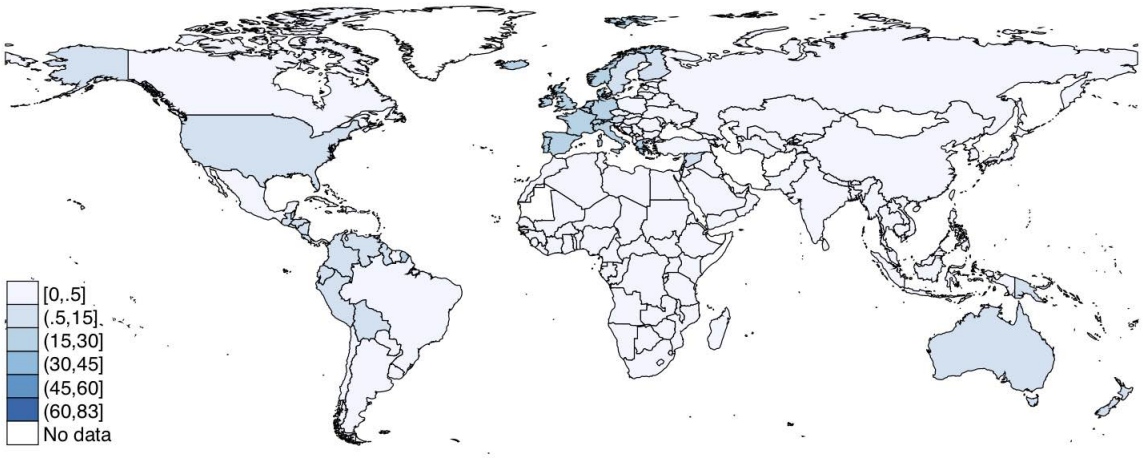
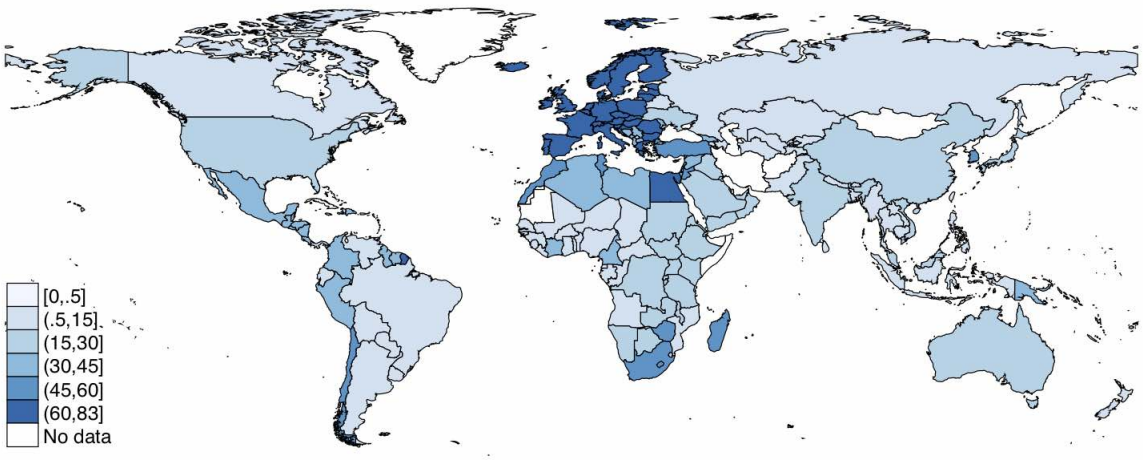


Figure 1.2: Number of partners sharing a PTA as of 1990



Source: Author's calculation based on the World Bank's Content of PTAs database version 1.0.

Figure 1.3: Number of partners sharing a PTA as of 2015

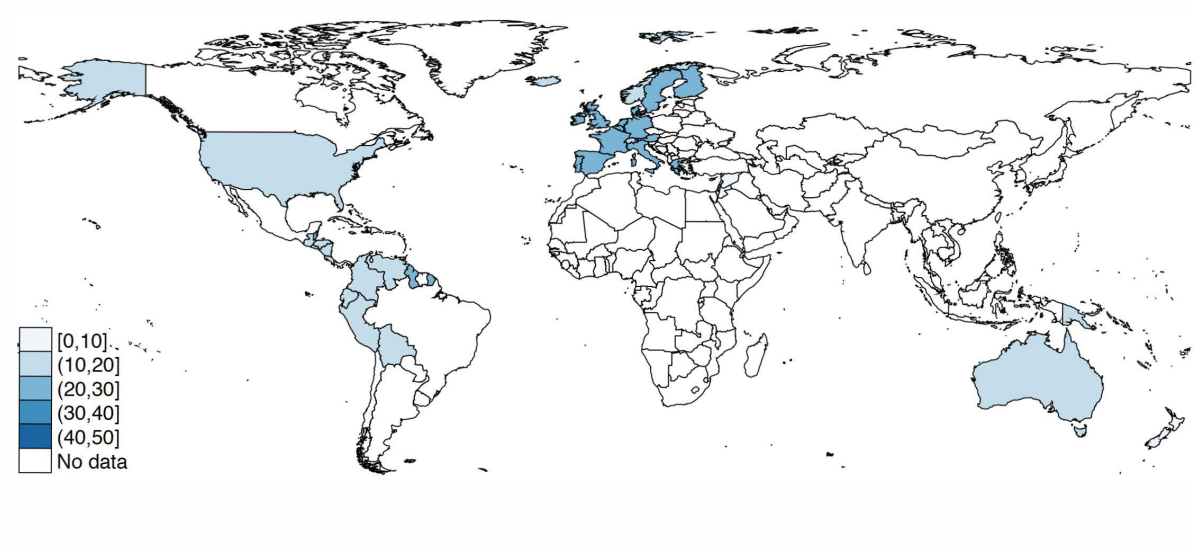
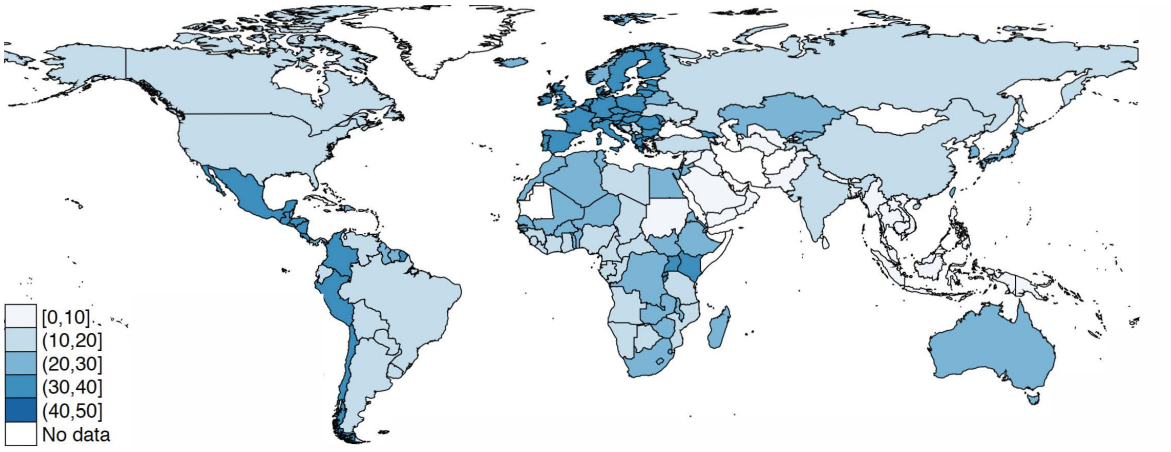
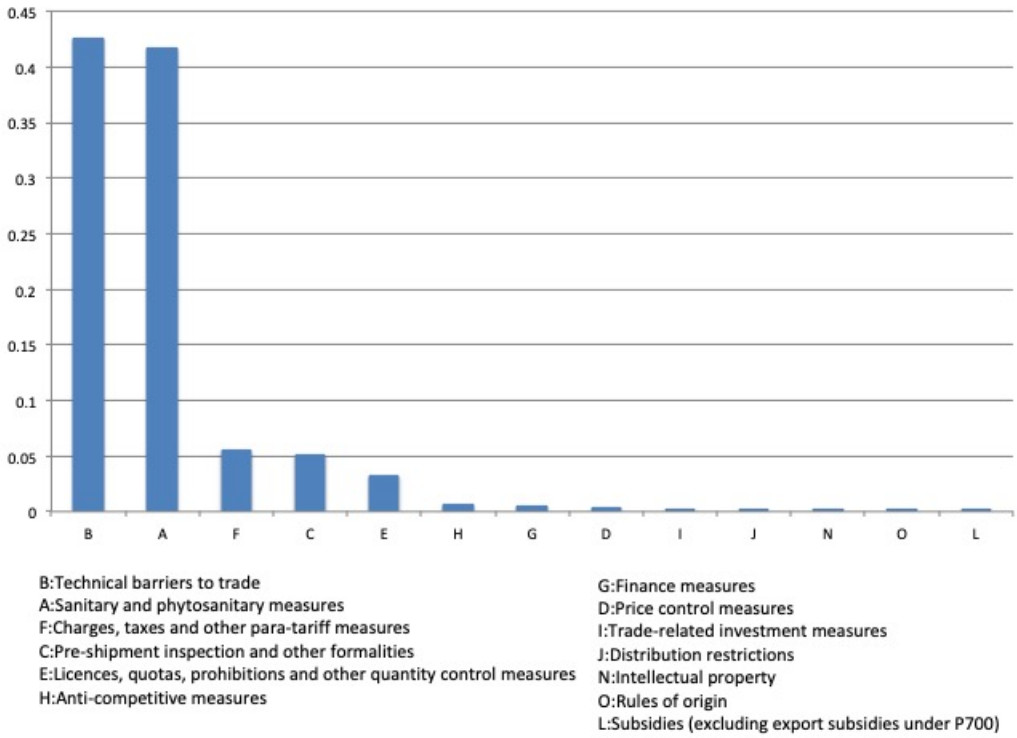


Figure 1.4: Average number of policy areas included in PTAs as of 1990



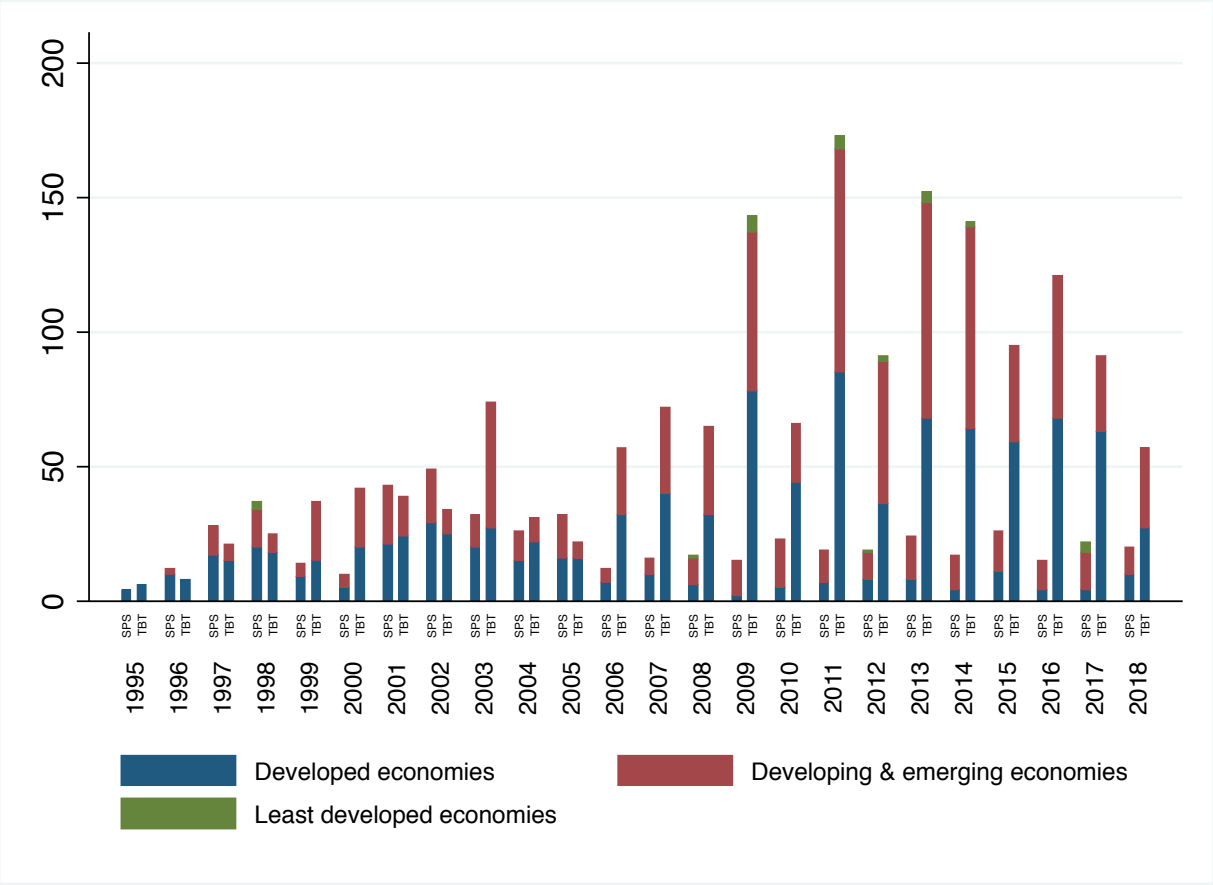
Source: Author's calculation based on the World Bank's Content of PTAs database version 1.0.

Figure 1.5: Average number of policy areas included in PTAs as of 2015



Note: Shares of NTMs recorded in the UNCTAD TRAINS database.

Figure 1.6: Overall incidence of NTMs



Sources: WTO's TBT and SPS committee.

Figure 1.7: Number of TBT and SPS-specific trade concerns raised to the WTO

1.6 Tables

Technical Measures	A	Sanitary and Phytosanitary measures
	B	Technical Barriers to trade
	C	Pre-shipment inspection and other formalities
Non Technical Measures	D	Contingent trade protective measures
	E	Non-automatic licensing and quantity control measures
	F	Price control measures, additional taxes and charges
	G	Finance measures
	H	Measures affecting competition
	I	Trade-related investment measures
	J	Distribution restrictions
	K	Restriction on post-sales services
	L	Subsidies
	M	Government procurement restrictions
	N	Intellectual property
	O	Rules of origin
Export measures	P	Export related measures

Table 1.1: Non-tariff measure classification from UNCTAD

All countries — 279 PTAs		North - North — 49 PTAs		South - South — 125 PTAs		North - South — 105 PTAs	
FTA Industrial	0.98	**FTA Industrial**	1.00	FTA Industrial	0.97	FTA Industrial	0.99
FTA Industrial	0.98	FTA Industrial	1.00	FTA Industrial	0.97	FTA Industrial	0.99
FTA Agriculture	0.98	FTA Agriculture	1.00	FTA Agriculture	0.97	FTA Agriculture	0.98
Customs	0.81	Customs	0.90	Export Taxes	0.74	Customs	0.91
Export Taxes	0.76	Export Taxes	0.82	Customs	0.70	Export Taxes	0.77
AD	0.56	AD	0.71	**Competition Policy**	0.49	TRIPs	0.71
TRIPs	0.54	TRIPs	0.71	TBT	0.49	AD	0.65
State Aid	0.53	**Movement of Capital**	0.71	SPS	0.45	**Movement of Capital**	0.65
Movement of Capital	0.50	State Aid	0.69	AD	0.42	GATS	0.61
GATS	0.50	GATS	0.69	State Aid	0.41	State Aid	0.59
TBT	0.49	Public Procurement	0.63	GATS	0.33	CVM	0.55
CVM	0.46	CVM	0.61	CVM	0.33	**IPR**	0.55
STE	0.43	TBT	0.57	TRIPs	0.33	STE	0.51
Competition Policy	0.41	STE	0.55	STE	0.31	Public Procurement	0.48
SPS	0.40	SPS	0.51	**Movement of Capital**	0.30	**Investment**	0.48
Public Procurement	0.38	**IPR**	0.51	**Investment**	0.27	TBT	0.46
Investment	0.38	TRIMs	0.47	Public Procurement	0.21	TRIMs	0.37
IPR	0.37	**Investment**	0.45	TRIMs	0.19	**Competition Policy**	0.30
TRIMs	0.31	**Competition Policy**	0.41	Statistics	0.16	SPS	0.30
Labour Market Regulation	0.11	**Visa and Asylum**	0.31	**IPR**	0.15	**Environmental Laws**	0.12
Visa and Asylum	0.11	**Labour Market Regulation**	0.31	Energy	0.06	**Visa and Asylum**	0.12
Environmental Laws	0.10	**Environmental Laws**	0.29	Agriculture	0.05	**Labour Market Regulation**	0.10
Statistics	0.10	Social Matters	0.27	**Labour Market Regulation**	0.04	Anti-Corruption	0.09
Energy	0.08	Energy	0.24	Mining	0.04	Agriculture	0.07
Agriculture	0.08	Research and Technology	0.22	Industrial Cooperation	0.03	Data Protection	0.07
Social Matters	0.07	Education and Training	0.22	Illicit Drugs	0.03	Social Matters	0.06
Approximation of Legislation	0.05	Taxation	0.22	**Visa and Asylum**	0.02	Illegal Immigration	0.04
Industrial Cooperation	0.05	Economic Policy Dialogue	0.20	Public Administration	0.02	Information Society	0.03
Research and Technology	0.05	Agriculture	0.18	**Environmental Laws**	0.02	Energy	0.03
Anti-Corruption	0.05	Industrial Cooperation	0.18	Approximation of Legislation	0.02	Consumer Protection	0.03
Illegal Immigration	0.05	Cultural Cooperation	0.18	Consumer Protection	0.02	Public Administration	0.03
Taxation	0.05	Financial Assistance	0.18	Taxation	0.02	Financial Assistance	0.03
Education and Training	0.04	Approximation of Legislation	0.18	Anti-Corruption	0.02	Approximation of Legislation	0.03
Financial Assistance	0.04	Illegal Immigration	0.18	Audio Visual	0.02	Regional Cooperation	0.02
Consumer Protection	0.04	Statistics	0.14	Terrorism	0.02	Research and Technology	0.02
Cultural Cooperation	0.04	Consumer Protection	0.12	Money Laundering	0.02	SME	0.02
Data Protection	0.04	Nuclear Safety	0.12	Information Society	0.01	Health	0.02
Economic Policy Dialogue	0.04	Regional Cooperation	0.06	Regional Cooperation	0.01	Cultural Cooperation	0.01
Public Administration	0.03	Public Administration	0.06	Research and Technology	0.01	Industrial Cooperation	0.01
Mining	0.03	Health	0.04	Education and Training	0.01	Innovation Policies	0.01
Nuclear Safety	0.02	Audio Visual	0.04	SME	0.01	Mining	0.01
Regional Cooperation	0.02	Anti-Corruption	0.04	Data Protection	0.01	Political Dialogue	-
SME	0.02	Data Protection	0.04	Economic Policy Dialogue	-	Education and Training	-
Audio Visual	0.01	SME	0.04	Innovation Policies	-	Economic Policy Dialogue	-
Health	0.01	Mining	0.04	Political Dialogue	-	Human Rights	-
Illicit Drugs	0.01	Terrorism	0.04	Cultural Cooperation	-	Taxation	-
Information Society	0.01	Human Rights	0.02	Social Matters	-	Statistics	-
Terrorism	0.01	Civil Protection	0.02	Health	-	Illicit Drugs	-
Money Laundering	0.01	Information Society	-	Financial Assistance	-	Money Laundering	-
Civil Protection	0.004	Political Dialogue	-	Human Rights	-	Audio Visual	-
Human Rights	0.004	Money Laundering	-	Nuclear Safety	-	Terrorism	-
Innovation Policies	0.004	Illicit Drugs	-	Civil Protection	-	Nuclear Safety	-

Source: World Bank's Content of PTAs database version 1.0

Note: Frequency of legally enforceable provisions on PTAs as of 2015. In blue WTO-plus provisions, in black WTO-X provisions, in bold-black WTO-X provisions related to investments

Table 1.2: Frequency of different types of provisions in PTAs

Chapter 2: A model of TBT/SPS measures in PTAs

2.1 Introduction

PTAs have become a prominent feature of the world trading system over the past 20 years. As they have increased in number, they have also broadened their scope by including provisions beyond merely market access. In order to quantify the impacts of the provisions included in PTAs, the trade policy literature faces several challenges to model the economic and policy structure of Non-Tariff Measures (NTMs). While it is straightforward to model provisions such as import quotas or export taxes with ad-valorem tariff equivalents, this technique is not suitable for provisions that do not purely deal with market access. Specifically, many NTMs are implemented to address important behind-the-border issues and not to discriminate against foreign businesses. Therefore, it would be misleading to restrict the effect of certain trade policies to their market access dimension. The goal of this chapter is to model the impact of two of the most frequent provisions in PTAs — Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary (SPS) provisions — by incorporating their impact on quality.

Based on the first version of the World Bank's Content of PTAs dataset, figure (2.1) shows that the number of PTAs that include TBT or SPS provisions

has been consistently increasing in recent years. In 2015, 74 percent of PTAs in force included TBT or SPS provisions, compared with 38 percent in 1995 (the year at which the WTO's Agreements on Technical Barriers to Trade and Sanitary and Phytosanitary Measures entered force). Moreover, all agreements that entered into force since 2009 have included TBT or SPS provisions. This supports the view that the perceived importance of standard-related NTMs as an obstacle to trade has increased over time, thus providing an incentive for countries to include TBT and SPS provisions in the negotiations of PTAs.

TBT/SPS measures encompass concurrent procedures that consist of standards, technical regulations, risk assessments, inspections, and conformity assessment procedures. Standards and technical regulations specify the required technical characteristics of a product (such as the level of electromagnetic radiation disturbance for some medical devices). Risk assessment refers to the likelihood of adverse effects of imports on humans, animals or the environment (which may depend on the origin of the shipment and the customs declaration). Inspections may be carried out in production facilities to verify good manufacturing practices (the US Food and Drug Administration carries out such inspections within and outside the US). Conformity assessment procedures define the testing procedures necessary to assess the conformity of products to established norms (testing is undertaken by third party conformity assessment bodies that must themselves be accredited/certified by governments). All these procedures are implemented to ensure minimum quality of products.

In general, TBT/SPS measures are not explicitly introduced for the purpose

of trade protection. They serve the laudable goals of protecting consumers, animals and environment health and safety. For example, in Europe, all products sold in the market must comply with relevant directives and regulations set by the European Commission. Upon completion of appropriate testing, these products are affixed with a CE marking visible to consumers and attesting to their conformity with EU regulations. Similarly, in the US, the Consumer Product Safety Commission is the federal regulatory agency in charge of "protecting the public against unreasonable risks of injury or death from consumer products", notably by examining imported shipments of consumer products. Overall, these measures bring information by signaling quality to consumers who do not have the capacity to evaluate the quality of a product by themselves. Voluntary adoption of TBT standards can also help markets operate more efficiently, by enabling firms to produce compatible goods and benefit from economies of scale. Nevertheless, neither the externality for the efficiency motives are not explicitly modeled in what follows. The next model simply focuses on the consequences of using TBT/SPS measures, that is establishing minimum quality requirements.

Yet, without cooperation on TBT/SPS procedures, differences can easily inhibit trade. Although the purpose of this chapter is not to study how countries design their TBT/SPS regulations, it is worth noting that different economic fundamentals can lead to different regulations. TBT/SPS measures are designed through the collaborative work of public and private experts. Because economic fundamentals, such as industry bargaining power, consumer preferences, institutions and technology levels, are the underlying factors guiding the choice of TBT/SPS mea-

sures, different countries with different fundamentals or preferences are likely to set different regulations. When TBT/SPS measures are implemented by two regions sharing equivalent economic fundamentals, like the US and the EU in some sectors for example, regulatory dissimilarity can generate unnecessary costs to exporters.

Different sources of information reveal the prevalence of TBT and SPS measures relative to other NTMs. As already shown in the Introductory chapter, the UNCTAD NTM database reveals that TBT and SPS are by far the most commonly implemented NTMs (see figure (1.6)). The UNCTAD NTM data is collected without taking into account the potential adverse effects of NTMS on trade, but other sources, such as the WTO's Specific Trade Concerns (STC) database, address this by recording the complaints of member states that face TBT/SPS measures with alleged discriminatory impacts on their exports. Figure (1.7), from chapter 1, shows that the incidence of complaints about TBT and SPS measures has been growing in recent years. Surveys carried out among stakeholders also reveal the burden imposed by differences in TBT/SPS measures between markets. Table (2.1) lists examples of regulatory divergences between the American and European pharmaceutical industries, that are perceived by businesses as the most important sources of barriers to trade. For instance, differences in the processes to approve new drugs enforced by the FDA for the US and the European Medicine Agency (EMA) for the EU significantly slow down the entry of new drugs in new markets. The total trade costs generated by these regulatory divergences (and not just the differences between FDA and EMA approval procedures) have been estimated using ad-valorem

equivalents and amount to USD 7.3 billion for the pharmaceutical sector.[1]

It is not the existence of TBT/SPS measures per se that creates barriers to trade, but rather their variety. Indeed, when regulations differ from one market to the other, exporting firms must incur additional costs to prove that their products comply with each export market's regulations. These costs might even prevent firms from exporting. In the previous chapter, I showed that TBT/SPS-related provisions were systematically included in the most recent PTAs. These were included in trade agreements even before the creation of the WTO in order to minimize the trade barriers caused by differences between regulations across trading partners.[2] TBT/SPS-related provisions in PTAs may take the form of mutual recognition or harmonization of regulations.[3] Practically, TBT/SPS-related provisions in PTAs allow exporters to prove their compliance with quality requirements only once, without needing to repeat the process of inspection, sampling, testing, certification, and the like in each destination market. TBT/SPS-related provisions arguably reduce barriers to trade, but we do not know their ultimate impact on the quality of imported goods. Because the stringency of TBT/SPS measures differs across countries, opponents to modern PTAs often argue that such types of integration will lower standards and have a negative impact on quality of imports. Conversely, market enlargement enabled by the reduction of fixed costs to export may foster vertical differentiation, or in other

[1] See [Ecorys, 2009] for more details on the methodology and costs for other sectors.

[2] Under the SPS and TBT Agreements, which came into force in 1995 with the creation of the WTO, members are strongly encourage to adopt international standards as a means to facilitate trade. Nevertheless, the WTO recognizes its members' rights to implement non-harmonized measures, as long as it is to achieve legitimate policy objectives.

[3] Chapter 3 provides more details on the different forms of TBT/SPS-related provisions existing in PTAs.

words differentiation through quality improvement. These two hypothesis need to be studied in a comprehensive theoretical framework that can accommodate market enlargement and regulatory mechanisms.

In this chapter, I examine the economic effects of the presence of TBT/SPS-related provisions in PTAs. I provide a theoretical framework, in which changes in the competitive and regulatory environments have an impact on both prices and quality. As previously mentioned, treating TBT/SPS measures as pure market access regulations is misleading and might overlook their direct impact on consumers' health and safety. Therefore, when studying such behind-the-border instruments that pertain to domestic policies, standard trade models require some adjustments to integrate their dual effect on consumers' protection (by ensuring a minimum quality of goods) and trade barriers (by increasing fixed costs to export).

In what follows, I propose a variant of the [Melitz, 2003] model with quality choice. Concretely, I model TBT/SPS measures as minimum quality requirements for the firms. Quality is costly to produce and directly linked to fixed investments. Firms optimally choose fixed investments to improve the quality of their production, while fulfilling minimum quality requirements. The trade policy of interest is the existence of a PTA that includes TBT/SPS regulations. The model is flexible enough to accommodate mutual recognition and harmonization of TBT/SPS measures. Without TBT/SPS integration, exporting firms face additional fixed costs to enter foreign markets because, on top of the domestic TBT/SPS compliances costs, they must show that their goods also comply with the destination market's regulations. Mutual recognition policies enable signatory countries to acknowledge

their trading partners' regulations as being equivalent to their own and therefore eliminate redundant TBT/SPS compliance costs. Domestic regulations are not expected to change in this case. Whereas harmonization policies support the adoption of common regulations, implying changes in regulations from at least one of the signatories. I show analytically that the implementation of both mutual recognition or harmonization policies results in an endogenous reduction of the fixed investments related to quality.

2.2 Related literature

This chapter is firstly related to the literature studying the economic impact of TBT/SPS measures. The model developed in the next sections provides the theoretical foundations to study the effects of mutual recognition or harmonization of TBT/SPS measures. Researchers have empirically studied the effects of such measures on trade and highlighted differences across sectors, integration approaches or trading partners. Using a measure of shared standards built from the Perinorm database[4], [Moenius, 2004] finds that country-specific standards hinder trade in sectors producing simple goods (e.g. food, beverages and agricultural products), but promote trade for more complex goods (e.g. machinery and electronics). The reason is that even though national standards may impose adaptation costs on exporters, they also provide exporters with valuable information to integrate a foreign market. Moenius argues that the negative effects due to adaption costs

[4]Perinorm is a bibliographic database (subscription only) that references national, European and international standards from more than 200 standards publishing organizations in 23 countries, with a total of more than 1,400,000 records.

are outweighed by the positive effects stemming from the reduction of transaction costs. [Portugal-Perez et al., 2010] find that EU standards for electronic products that are harmonized to international standards have a significant and positive net effect on EU imports. [Chen and Mattoo, 2008] compare the effects of the harmonization and mutual recognition of TBT measures in PTAs on signatories and third countries. Instead of building a measure of shared standards, they rely on official documents to identify the provisions associated with harmonization and mutual recognition. Their analysis confirms that both types of agreement increase trade between participating countries, but find different implications for third countries. A harmonization of standards tends to increase exports from developed third parties but reduces them from developing ones. One reason might be that harmonized standards are likely to be stricter in the participating countries, which would increase the costs of adaptation of the excluded developing countries more than the benefit of the economies of scale engendered by the harmonized region. By contrast, the authors find that mutual recognition has more symmetric benefits for participating and excluded countries. Unless the agreement contains restrictive rules of origin, imports from both developed and developing excluded countries increase. Using a similar strategy based on the screening of the treaties' texts, [Disdier et al., 2015] analyze the impact on trade of technical regulations incorporated in North-South trade agreements. To map the legal texts, the authors follow the same template as [Budetta and Piermartini, 2009] and search for phrases associated with harmonization or mutual recognition. They find that developing countries expand their trade with their high income partners following deep integration agreements on stan-

dards. But this happened at the expense of their trade with non-bloc developing partners.

This chapter is also related to the literature on quality choice, in particular to the works of [Antoniades, 2015], [Johnson, 2012] and [Gervais, 2013]. These studies focus on predicting trade patterns based on heterogeneous firm characteristics and measuring the gains from trade openness. I instead focus on the changes in quality from the implementation of a behind-the-border policy. As explained in the introductory chapter, commitments related to TBT and SPS measures are expected to generate wider effects than the traditional PTAs' commitments on market access. The implementation of such NTMs has implications for both barriers to trade and product quality. By changing the way TBT and SPS measures are implemented, I argue that PTAs trigger supply-side responses affecting endogenous variables that eventually modify the average level of product quality. Using a multi-country, multi-sector, heterogeneous firms model that incorporates a quality choice mechanism, I show how changes in trade barriers due to TBT and SPS commitments eventually impact the overall level of product quality.

Finally, while I do not derive a full general equilibrium model, I show what would be the challenges of doing so. The traditional literature on PTAs focuses on market access mechanisms. Leading examples are [Caliendo and Parro, 2014], who develop a structural model with sectoral input-output linkages to quantify the impact of NAFTA, and [Anderson et al., 2016], who calculate the general equilibrium effects of all PTAs using iterated gravity estimations. On the empirical side it also has a long history of using Computable General Equilibrium (CGE) tech-

niques. It largely resorts on the use of ad-valorem equivalents to inform policy makers on the potential impact of "mega-trade deals", such as the defunct TTIP ([Francois et al., 2013] and [Fontagné et al., 2013]) or most recently the renegotiation of NAFTA ([Dadkhah et al., 2019]). While the use of ad-valorem equivalents or restrictiveness indices provides interesting insights on the global consequences of tackling behind-the-border barriers, the CGE methodology must rely on restrictive modeling assumptions and is not flexible enough to address structural changes following TBT/SPS provisions for instance. Concretely, in a scenario in which countries neither mutually recognize nor harmonize their TBT/SPS measures, markets are segmented and firms make separate optimal quality decisions based on their destination-specific profits. Following the policy change of entering into a trade agreement with TBT/SPS provisions, markets are not segmented anymore (at least from the quality point of view) and firms optimally choose quality based on their overall profits. Therefore, the structure of my model moves from separated markets to joint markets, which ultimately limits my ability to solve the model analytically.

2.3 Model

In this section, I develop a static model in which consumers value the quality of the goods they consume. Firms operate in a monopolistically competitive environment as in [Melitz, 2003] and compete through both price and quality. The quality introduced in this model has both horizontal and vertical attributes. The former is due to the consumer's love for quality and the latter to the firm's abil-

ity to differentiate through quality. I assume that countries implement TBT and SPS measures solely to ensure minimum quality.[5] In practice, firms must prove that their production satisfies a series of minimum quality requirements (guided by the adoption of standards). In the current framework, the TBT/SPS measures, or equivalently the minimum quality requirements, are exogenous. However, the choice of quality is endogenous to the firms. The government's decision to harmonize with or mutually recognize its trading partner's own TBT/SPS measures represents the trade policy of interest.

Quality is costly to produce and I assume it is related to fixed costs. Hence, by increasing fixed costs, minimum quality requirements influence the firms' decision to enter a market. In terms of notation, there are N countries indexed by i for exporters and j for importers, and S products indexed by s. Each country j is populated with L_j consumers supplying one unit of work and whose wage rate is w_j. They demand x_{ijs} units of product s produced in country i, of quality q_{ijs}.

2.3.1 TBT and SPS measures

One way to model the fact that a product is safe for consumption is to establish market-specific minimum quality requirements. Figure 2.2 shows the quality adjusted consumers' demand $q \times x$ in terms of product quality q. The zero demand

[5] As in [Costinot, 2008], quality standards are implemented to protect consumers against harmful products. This type of standards help reduce the information cost for consumers who can appraise and compare different product qualities satisfying different standards. Another characteristic of standards that I do not consider in this chapter is their network effect of making products compatible with each other. [Gandal and Shy, 2001] study effect of mutual recognition when the network effects of standards are at play, i.e. when the value of a product increases with the number of consumers that use compatible products.

to the left of $\underline{q}$ illustrates the fact that a product can only be sold in a market if it satisfies the minimum quality requirements imposed by the authorities, otherwise it is not authorized for sale in the market. Consumers' love for quality explains the increasing relationship between quality and quality-adjusted demand.

On the supply side, the monopolistic firms optimally choose the quality of their production accounting for consumers' quality-adjusted demand. The central modeling feature is that firms can improve the quality of their production by investing into fixed costs. The quality of product s manufactured and sold in the same domestic market i is described by the functional form:

$$q_{iis} = f_{iis}^{\psi_s} \tag{2.1}$$

The parameter ψ_s is the technology of quality production and indicates how much quality improves after investing in one more unit of fixed costs. It is also tied to the product-level perception of quality. For instance, quality is not perceived and valued the same way for wines versus cars.

For each product s, there is a minimum quality requirement that operates as a selection mechanism. Firms' optimal quality must satisfy the domestic minimum quality requirement $q_{iis} > \underline{q}_{is}$ or equivalently the corresponding minimum fixed cost threshold $f_{iis} > \underline{f}_{iis}$.

Quality requirements are market specific, as countries may not enforce the same regulations. Figure 2.3 shows a scenario where country i has adopted more stringent regulations than country j. A firm located in country i perceives $\underline{q}_i$ as a

domestic regulation and $\underline{q}_j$ as a foreign regulation. Without agreement on TBT/SPS measures, imported goods may be subject to duplicated minimum quality requirements, adding to the fixed costs required to comply with each destination market's regulations. In the example of figure 2.3, even though quality requirements in market i are higher than that of market j, a firm located in i is still required to spend at least $\underline{q}_j^{\frac{1}{\psi_s}}$ in additional fixed costs to be able to sell in market j.

The quality equation for imported products is:

$$q_{ijs} = [(f_{iis})^{\eta_{ijs}}(f_{ijs})^{1-\eta_{ijs}}]^{\psi_s}, \quad \text{where} \quad 0 \leq \eta_{ijs} \leq 1 \tag{2.2}$$

In which the policy parameter η_{ijs} represents the degree of integration between country j's and country i's regulations for product s. If $\eta_{ijs} = 0$, countries i and j do not recognize/harmonize their regulations, whereas if $\eta_{ijs} = 1$ they fully recognize/harmonize their regulations. Notice here that it is not necessary to have different minimum quality requirements across countries to create distortion. The fact that countries might not recognize compliance with foreign regulations will force firms to further spend on f_{ijs} to establish the quality of their exported production. For sake of simplicity, I derive equilibrium solutions for three cases, the no recognition/harmonization case, superscripted with NR, and two closely related integration cases: full mutual recognition MR and harmonization HR which differ by the minimum quality constraint $\underline{q}_s$ ultimately enforced by the PTA. Under mutual recognition, one can argue that countries would stick to their domestic regulations in order to save costs from adaption. Under harmonization, the minimum quality

is expected to change to the most stringent direction denoted $\underline{q}_s^{HR}$, at least more stringent for the countries with the lowest minimum standards.

To summarize, the corresponding functional forms under no recognition and full integration is:

$$\text{no recognition} \quad q_{ijs}^{NR} = \begin{cases} (f_{ijs})^{\psi_s} & \text{if } q_{ijs} \geq \underline{q}_{js} \\ 0 & \text{else} \end{cases}$$

$$\text{mutual recognition} \quad q_{ijs}^{MR} = \begin{cases} (f_{iis})^{\psi_s} & \text{if } q_{ijs} \geq \underline{q}_{is} \\ 0 & \text{else} \end{cases} \qquad \forall i, j \qquad (2.3)$$

$$\text{harmonization} \quad q_{ijs}^{HR} = \begin{cases} (f_{iis})^{\psi_s} & \text{if } q_{ijs} \geq \underline{q}_s^{HR} \\ 0 & \text{else} \end{cases}$$

Markets are segmented under no recognition (NR), which implies that firms make independent decisions regarding quality for each of the markets they can export to. They will pick an optimal domestic quality investment f_{iis} and as many bilateral fixed cost investments f_{ijs} as there are exporting markets. However, under full integration (MR or HR) markets are not separable anymore. Consequently, firms make one single optimal joint decision regarding the quality of their product. They only pick f_{iis}, which will be recognized by any country j sharing TBT/SPS provisions with country i. The distinction between separable markets and joint markets is the central mechanism of behind-the-border mechanism entailed by TBT/SPS integration.

2.3.2 Consumer's problem

The representative consumer's problem is a quality-augmented version of the consumer's problem in the Melitz model. Preferences are represented by a Dixit-Stiglitz utility function, in which the demand for a given variety $x_{ijs}(\nu)$ is shifted by a quality multiplier $q_{ijs}(\nu)$. The consumer's income E_j is the sum of labor income $w_j L_j$ and firms' profit π_j. The representative consumer's maximization problem[6] in country j is:

$$\max_{\{x_{ijs}(\nu)\}} U_j = \prod_{s=1}^{S} \left(\sum_{i=1}^{N} \int_{\nu \in \Omega_{is}} \left(q_{ijs}(\nu) x_{ijs}(\nu)\right)^{\frac{\sigma_s - 1}{\sigma_s}} d\nu \right)^{\frac{\sigma_s}{\sigma_s - 1} \mu_{js}} \tag{2.4}$$

$$s.t. \sum_{s=1}^{S} \sum_{i=1}^{N} \int_{\nu \in \Omega_{is}} p_{ijs}(\nu) x_{ijs}(\nu) d\nu = \sum_{s=1}^{S} \mu_{js} E_j \tag{2.5}$$

Where $x_{ijs}(\nu)$ is consumer j's demand for the variety ν of a product s that is produced in country i, which is associated with price $p_{ijs}(\nu)$ and quality $q_{ijs}(\nu)$, and Ω_{is} the set of varieties. Finally, $\sigma_s > 1$ is the elasticity of substitution between varieties consumed and μ_{js} is the share of income E_j that country j spends on product s. Solving the consumer's maximization problem gives the usual CES demand function for differentiated goods adjusted for quality. At identical prices, consumers demand

[6]The present model does not incorporate negative externality from consuming very low quality goods, but actually focuses on the government's response to solve it. Practically, a negative consumption externality (modeled as an extra term in the consumer's utility function equal to -∞ if the aggregate consumption is of quality below some minimum standard and 0 otherwise) would encourage the benevolent government to restrict quality to a certain minimum threshold. The government would still choose to restrict quality as a second best for any other levels of negative externality.

more products of higher quality.

$$x_{ijs}(\nu) = p_{ijs}(\nu)^{-\sigma_s} q_{ijs}(\nu)^{\sigma_s - 1} \tilde{P}_{js}^{\sigma_s - 1} \mu_{js} E_j \tag{2.6}$$

For which I define $\tilde{P}_{js}$, the quality-adjusted price index in country j for product s:

$$\tilde{P}_{js} = \left[\sum_{i=1}^{N} \int_{\nu \in \Omega_{is}} \left(\frac{p_{ijs}(\nu)}{q_{ijs}(\nu)} \right)^{-(\sigma_s - 1)} d\nu \right]^{\frac{1}{1-\sigma_s}} \tag{2.7}$$

2.3.3 The firm's profit maximization problem

As usual in a Melitz-like heterogeneous firms model, firms differ in productivity and each of them monopolistically supplies a single variety ν of a differentiated good. Ex-ante there is a large pool of identical firms. In addition to the fixed costs related to the quality regulations introduced in the previous section, firms producing product s must pay fixed entry cost f_s^e to enter their domestic market.

Upon entry, each firm draws its productivity φ from a Pareto distribution $G_{is}(\varphi) = 1 - \left(\frac{b_{is}}{\varphi}\right)^{\theta_s}$, where b_{is} is the minimum productivity and θ_s is the productivity dispersion. The corresponding production function is therefore $y(\nu) = \varphi(\nu)\ell(\nu)$, where $\ell(\nu)$ is the labor input. Firms may decide to export, in which case they have to pay variable iceberg trade costs $\tau_{ijs} \geq 1$. A firm must ship $\tau_{ijs} x_{ijs}$ units of goods in order to sell x_{ijs} units of that good to country j. I set $\tau_{iis} = 1$ so that variable international trade costs are expressed relative to domestic trade costs and payable in domestic labor units. Importing country j may levy tariff t_{ijs} on imports from country i. In addition to the iceberg costs, tariffs create a wedge between factory

and consumer prices $p_{ijs} = t_{ijs}\tau_{ijs}p_{is}$. Moreover, exporting firms face other fixed operating costs F_{ijs} related to doing business in country j, such as market research, distribution and marketing costs. Lastly, TBT/SPS domestic regulations require firms to fulfill minimum quality requirements. In this extended Melitz model, firms not only decide whether or not to export and at which price, but also choose the quality of their product to attract more demand. They improve quality by making fixed cost investments as described by equation (2.2). All fixed costs — entry costs f_{is}^e, regulatory costs f_{iis} and f_{ijs}, and distribution costs F_{ijs} — are payable in domestic labor unit w_i.

Firms optimally choose their export destinations, corresponding prices and investments in quality to maximize their total profits from all domestic and foreign sales. Total profits of a firm from country i producing variety ν and selling to a certain number of destinations k are as follows:

$$\pi_{is}(\nu) = \underbrace{p_{is}(\nu)x_{iis}(\nu) - w_i\ell_{iis}(\nu) - w_i f_{iis} - w_i F_{iis}}_{\pi_{is}^{domestic}(\nu)} + \underbrace{\sum_{k\neq i} \frac{p_{iks}(\nu)x_{iks}(\nu)}{t_{iks}} - w_i\ell_{iks}(\nu) - w_i f_{iks} - w_i F_{iks}}_{\pi_{is}^{foreign}(\nu)}$$

$$s.t. \quad \ell_{iis}(\nu) = \frac{x_{iis}(\nu)}{\varphi(\nu)} \text{ and } \ell_{iks}(\nu) = \frac{\tau_{iks}x_{iks}(\nu)}{\varphi(\nu)}$$

Without loss of generality and because of CES preferences, I can separate the price optimization from the destination and quality optimization. Under monopolistic

competition, a firm of productivity φ sets the usual price with constant mark-up:

$$p_{ijs}(\nu) = \frac{\sigma_s}{\sigma_s - 1} \frac{t_{ijs}\tau_{ijs}w_i}{\varphi(\nu)} \tag{2.8}$$

Given this price, the firm chooses the optimal qualities and destination markets for its goods sold domestically or intended for export. The timing for export decision and optimal quality choice is as follows: first, the firm selects potential destination markets; and second, given the optimal quality associated to those destinations it verifies whether its total revenues can cover the fixed investment in exported quality f and the usual fixed exporting costs F.

Moreover, the way firms pick their optimal quality and destination markets depends on the state of recognition of TBT/SPS measures. When countries do not recognize each other's regulations (NR), markets are segmented and firms pick a set of market-specific qualities solely based on the sales in each market. Market selection operates as in Melitz through the condition of positive profits, and fixed exporting costs F for one market do not influence the choice to export to other markets.

However, when countries fully integrate their regulations (MR or HR), firms make a unique joint decision on their optimal quality, based on their total sales from all markets. Therefore, it is important to think about quality optimization in terms of total profits defined by equation (2.8). The decision to export to several markets ultimately impacts the optimal quality, but also the total amount of fixed costs (from investment in quality and exports). Depending on the size of the other

fixed costs to export F, a firm may decide to drop one destination market and choose a lower quality. The sequence of decisions for the joint market scenario can be implemented backward: i) the firm evaluates what would be its optimal quality if it were to export to k markets, ii) if the total revenues from exports cannot cover the total fixed costs to exports and fixed investment in quality, then the firm can drop a market and choose a lower quality optimized on $k-1$ markets. For k markets, there are $k!$ possible combinations of destination choices. This cannot be solved with algebra because revenues depend on moving endogenous variables and cannot easily be compared to fixed export costs. Nevertheless, in what follows I describe the optimal choice of quality for k markets and argue in the next section that the exporting thresholds can be determined by the most constrained firms (- i.e. for which the minimum quality constraint binds).

Appendix B details the methodology to solve the following firm's profit maximization problem under non-recognition (NR):

$$\max \pi(f_{i1}, f_{i2}, ..., f_{ik}) = \sum_{j=1}^{k} \frac{\mu_j E_j}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j} \right)^{1-\sigma} f_{ij}^{\psi(\sigma-1)} - w_i \sum_{j=1}^{k} (f_{ij} + F_{ij}) \tag{2.9}$$

subject to

$$\forall j \in (1, ..., k), \quad f_{ij} > \underline{f}_j \tag{2.10}$$

The resulting optimal interior solutions for qualities are given by:

$$q_{ijs}^{opt,NR} = \left[\Delta_s \frac{(t_{jis}\tau_{ijs}w_i)^{1-\sigma_s}}{w_i t_{ijs}} \underbrace{\left(\frac{\mu_{js}E_j}{\tilde{P}_{js}^{1-\sigma_s}} \right)}_{A} \varphi^{\sigma_s - 1} \right]^{\frac{\psi_s}{1-\psi_s(\sigma_s-1)}} \tag{2.11}$$

where $\Delta_s = \frac{\psi_s(\sigma_s-1)}{\sigma_s} \left(\frac{\sigma_s}{\sigma_s-1} \right)^{1-\sigma_s}$ and corner solutions $q_{ijs}^{opt,NR} = \underline{q}_{js}$. Not surprisingly, quality increases with firm's productivity and the perception of quality ψ_s within a product category. The term A represents the role played by market size in the optimal quality decision. Larger markets are associated with higher incentive for quality improvement, as firms will be able to reap the costs from exporting to new markets by increasing their supplied quality and attracting more demand.

On the other hand, if countries fully recognize each other's TBT/SPS measures (MR or HR), firms only have to pick their domestic quality, which will be recognized everywhere there is a mutual recognition agreement. Consequently, this TBT/SPS agreement provides incentives to invest into higher quality production, since firms expect to recover their fixed costs from higher sales abroad. Appendix B shows that if firms choose to export to the whole PTA market, the resulting optimal interior solution for quality under full integration (MR or HR) is given by:

$$q_{is}^{opt,MR/HR} = \left[\Delta_s \sum_{\{j \in PTA_{ijs}\}} \left(\frac{\mu_{js}E_j}{\tilde{P}_{js}^{1-\sigma_s}} \right) \varphi^{\sigma_s - 1} \right]^{\frac{\psi_s}{1-\psi_s(\sigma_s-1)}} \tag{2.12}$$

and corner solution $q_{is}^{opt,MR} = \underline{q}_s$. Here we observe the impact of market size enlargement on quality, which is the first of the two effects implied by TBT/SPS

provisions. Integrated markets offer firms a broader range of export destinations. If other export fixed costs are not too large to prevent firms from reaching new destinations, (2.12) shows how increased market access affects quality. This expression shows that mutual recognition agreements provide incentives to invest into higher quality production since firms can expect to recover their fixed export costs from higher sales abroad. For all other countries outside the PTA with TBT/SPS provisions, the firms will pick $q_{ijs}^{opt,NR}$ as defined by expression (2.11).

Finally, the expression of optimal quality for non-exporters is similar under no integration or full integration:

$$q_{iis}^{opt} = \left[\Delta_s \frac{\mu_{is} E_i}{w_i^{\sigma_s} \tilde{P}_{is}^{1-\sigma_s}} \varphi^{\sigma_s - 1}\right]^{\frac{\psi_s}{1-\psi_s(\sigma_s-1)}} \tag{2.13}$$

TBT/SPS provisions also affect non-exporters through general equilibrium changes in price index and wages. Without solving the general equilibrium problem, it is not clear how change in competition will affect non-exporters.

2.3.4 Productivity thresholds

The constrained maximization problem used to derive the above solution for optimal quality ensures that minimum quality requirements are satisfied for both interior and corner solutions. The productivity threshold to export is obtained from finding the minimum φ for which profits are positive.

- Under no recognition (NR), each destination market has a separate productivity threshold:

$$\varphi_{ijs}^{*,NR} = \underline{q}_{js}^{\frac{1-\psi_s(\sigma_s-1)}{\psi_s(\sigma_s-1)}} \left(1 + \frac{F_{ijs}^{\psi_s}}{\underline{q}_{js}}\right)^{\frac{1}{\psi_s(\sigma_s-1)}} [\Gamma_{ijs}]^{\frac{-1}{\sigma_s-1}} \tag{2.14}$$

where I denote $\Gamma_{ijs} = \Delta_s \frac{\mu_{js} E_j}{w_i^{\sigma_s} \tilde{P}_{is}^{1-\sigma_s}}$

- Under mutual recognition or harmonization, as explained in appendix B, firms can always opt out of an export market and adjust their optimal quality accordingly, thus lowering the fixed costs to export (from both TBT/SPS measures and Melitz-like costs). Ultimately the minimum threshold is driven down to the corner solution threshold that cannot be lowered further.

$$\varphi_{is}^{*,MR/HR} = \underline{q}_s^{\frac{1-\psi_s(\sigma_s-1)}{\psi_s(\sigma_s-1)}} \left(1 + \frac{\sum_{\{j \in PTA_{ijs}\}} F_{ijs}^{\psi_s}}{\underline{q}_s}\right)^{\frac{1}{\psi_s(\sigma_s-1)}} \underbrace{\left[\sum_{\{j \in PTA_{ijs}\}} \Gamma_{ijs}\right]^{\frac{-1}{\sigma_s-1}}}_{A} \tag{2.15}$$

The difference between MR and HR lies in the minimum quality regulation ultimately enforced by the PTA, $\underline{q}_{is}$ for MR and $\underline{q}_s^{HR}$ for HR. Notice that market size also has an impact of the export threshold through the term A.

2.4 Aggregated quality

In this section, I derive the expression of the aggregated quality of imported goods. Let us define the aggregated quality of imported goods by $\tilde{q}_{ijs} = \int_{\nu_{is} \in \Omega_{is}} q_{ijs}^{opt}(\nu) d\nu$. The integral can be decomposed between the mass of firms for which the minimum quality constraint binds ($q^{opt} = \underline{q}$) and those that are not constrained and choose an interior solution defined by equations (2.11) or (2.12).

The integral over the constrained firms with probability $P(\varphi = \varphi^*)$ is zero,

because the Pareto distribution is continuous at φ^*. The aggregated quality is therefore integrated over the interior solutions and becomes:

$$\tilde{q}_{ijs} = M_{ijs} \int_{\varphi^*}^{\infty} q_{ijs}^{opt}(\varphi) g_{is}(\varphi|\varphi > \varphi_{ijs}^*) d\varphi = M_{ijs} \int_{\varphi^*}^{\infty} q_{ijs}^{opt}(\varphi) \left(\frac{\varphi_{ijs}^*}{\varphi}\right)^{\theta_s} d\varphi$$
$$= \underbrace{\frac{\theta_s}{\frac{\psi_s(\sigma_s-1)}{1-\psi_s(\sigma_s-1)} - \theta_s}}_{\Upsilon_s} M_{ijs} \left[\Gamma_{ijs}\right]^{\frac{\psi_s}{1-\psi_s(\sigma_s-1)}} \left(\varphi_{ijs}^*\right)^{\frac{\psi_s(\sigma_s-1)}{1-\psi_s(\sigma_s-1)}}$$

where M_{ijs} represent the number of exporters from i to j, which is also equivalent to the number of varieties, and $\Gamma_{ijs} = \Delta_s \frac{\mu_{js} E_j}{w_i^{\sigma_s} \tilde{P}_{is}^{1-\sigma_s}}$. Next, I substitute in the equations of the productivity thresholds (2.14) and (2.15) to obtain the simple expressions:

$$\tilde{q}_{ijs}^{NR} = \Upsilon_s b_{is}^{\theta_s} M_{ijs} \underline{q}_{js} \left(1 + \frac{F_{ijs}^{\psi_s}}{\underline{q}_{js}}\right)^{\frac{1}{\psi_s(\sigma_s-1)}}$$
$$\tilde{q}_{ijs}^{MR/HR} = \Upsilon_s b_{is}^{\theta_s} M_{ijs} \underline{q}_s \left(1 + \frac{\sum_{\{j \in PTA_{ijs}\}} F_{ijs}^{\psi_s}}{\underline{q}_s}\right)^{\frac{1}{\psi_s(\sigma_s-1)}}$$

As expected, average quality is positively correlated with minimum quality requirements $\underline{q}$, but also depends on the level of competition through the term M_{ijs} corresponding to the number of exporters. Therefore, there is both a regulatory channel and a market size channel behind the average aggregate level of quality. In the next chapter, I empirically investigate which of the two channels prevails in the overall impact of a PTA including TBT/SPS-related provisions.

I rewrite the above equations in terms of variables that will be easier to control for in the econometric specification. Let us recall that the number of exporting

firms from i to j, M_{ijs}, can be expressed probabilistically as a share of M^e_{is}, the firms originally entering market i: $M_{ijs} = prob(\varphi > \varphi^*_{ijs})M^e_{is} = [1 - G_{is}(\varphi^*_{ijs})]M^e_{is} = (\frac{b_{is}}{\varphi^*_{ijs}})^{\theta_s} M^e_{is}$. Plugging in this expression in the above quality expressions gives:

$$\tilde{q}^{NR}_{ijs} = \Upsilon_s b^{\theta_s}_{is} M^e_{is} \left[\Gamma_{ijs}\right]^{\frac{\theta_s}{\sigma_s - 1}} (\underline{q}_{js})^{1-\theta\frac{1-\psi_s(\sigma_s-1)}{\psi_s(\sigma_s-1)}} \left(1 + \frac{F^{\psi_s}_{ijs}}{\underline{q}_{js}}\right)^{\frac{1}{\psi_s(\sigma_s-1)}} \tag{2.16}$$

$$\tilde{q}^{MR/HR}_{ijs} = \Upsilon_s b^{\theta_s}_{is} M^e_{is} \left[\sum_j \Gamma_{ijs}\right]^{\frac{\theta_s}{\sigma_s - 1}} (\underline{q}_s)^{1-\theta\frac{1-\psi_s(\sigma_s-1)}{\psi_s(\sigma_s-1)}} \left(1 + \frac{\sum_{\{j \in PTA_{ijs}\}} F^{\psi_s}_{ijs}}{\underline{q}_s}\right)^{\frac{1}{\psi_s(\sigma_s-1)}} \tag{2.17}$$

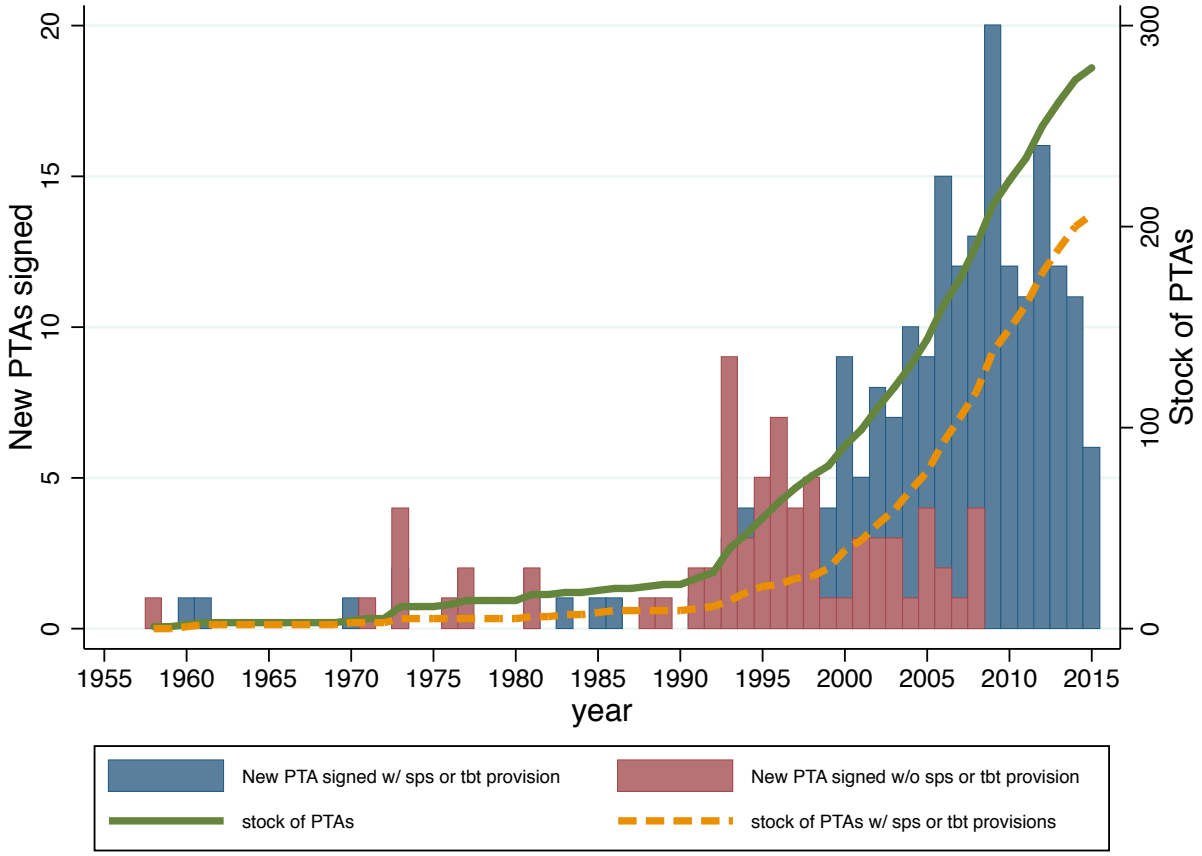
where $\Gamma_{ijs} = \frac{\psi_s(\sigma_s-1)}{\sigma_s} \left(\frac{\sigma_s}{\sigma_s - 1} \frac{t_{ijs}\tau_{ijs}w_i}{\tilde{P}_{js}}\right)^{1-\sigma_s} \frac{\mu_{js}E_j}{w_i t_{ijs}}$. Some intuitive remarks can be made by comparing (2.16) and (2.17). Since $\sigma_s > 1$, TBT/SPS agreements increase quality through access to a larger market (from E_j to $\sum E_j$). Tariffs t and iceberg trade costs τ depress the quality of imports. The overall productivity level in the exporting country b_{is} is positively related to quality. Increases in the regulatory parameter $\underline{q}$ can actually increase or decrease the average level of quality. Indeed, to this point I have set the ex-post minimum quality requirement after mutual recognition of TBT/SPS measures to the one implemented in the domestic country. However, one could think about a situation in which exporting firms can choose where to obtain their certifications and will eventually get certified in the country where it is the cheapest. Also, countries might agree to harmonize to more stringent TBT/SPS measures, committing for example to international standards. The regulatory channel will depend on whether the agreement calls for mutual recognition

versus harmonization.

2.5 Conclusion

The model developed in the present chapter can serve different empirical and quantitative purposes. The framework reveals how the economic structure of the model is changed by PTAs including TBT/SPS provisions. Fully solving the model cannot be done analytically, but could be approached with quantitative methods in further work. In the next chapter, I show how empirical analysis of the impact of TBT/SPS provisions on quality can shed light on the market size and regulatory channels described in the present theoretical chapter.

2.6 Figures



Source: World Bank's Content of PTAs database version 1.0

Figure 2.1: Incidence of TBT and SPS chapters in PTAs

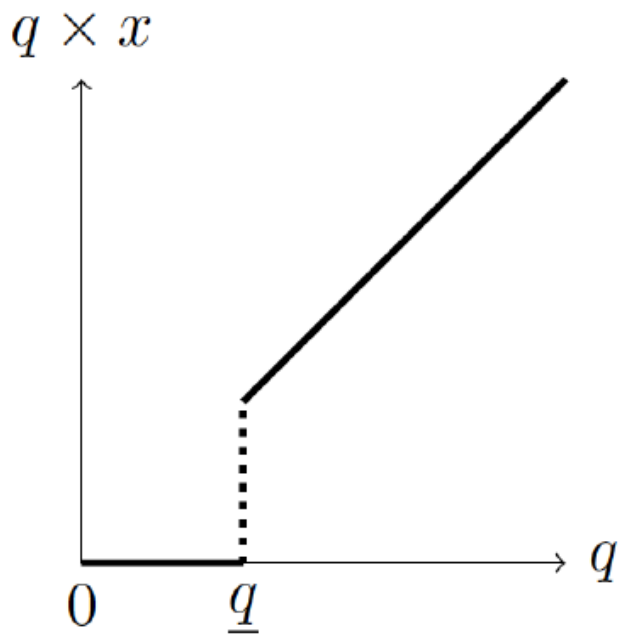


Figure 2.2: Minimum quality requirements

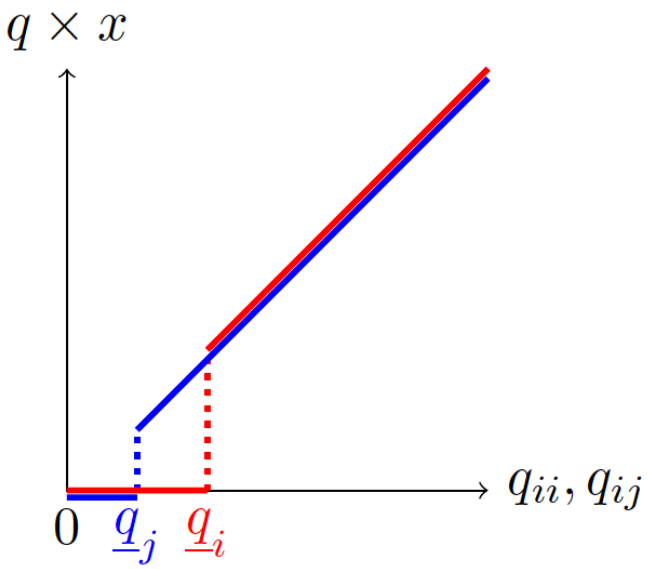


Figure 2.3: Domestic and foreign minimum quality standards

2.7 Tables

(a) Most important perceived NTMs from the EU to the US

1	Restrictions or bans on use of specific chemicals
2	Classification and labeling requirements for chemical products
3	Threat of 100% container scanning
4	FDA New Drug Approval Process
5	Drug precursor legislation
6	Double certification need caused by the European Union Authorized Economic Operator program and the US Customs CTPAT program
7	US state level safety certifications
8	Prior authorization for sensitive product categories
9	Pre-shipment inspections
10	Non recognition of "Made in EU"

(b) Most important perceived NTMs from the US to the EU

1	EU pricing policy member state differences
2	Health technology assessment differences
3	Different rules in various Member States concerning authorization of pharmaceuticals
4	International reference pricing
5	Therapeutic reference pricing
6	Differences in the enforcement of the unified customs system across EU member states
7	Parallel trade allowance
8	Restrictions concerning information distribution to patients
9	New EU Member States compliance with undisclosed data protection
10	Prohibitions (e.g. security, sensitive products, political reasons, etc.)

Source: [Ecorys, 2009]

Table 2.1: Examples of most important trade NTMs perceived by businesses in the pharmaceutical industry

Types of concerns raised		Stated objectives for the measures raised as STCs	
further information, clarification	387	Protection of Human health or safety	277
unnecessary barrier to trade	347	Protection of the environment	137
transparency	319	Other	108
other issues raised (free text)	263	Prevention of deceptive practices and consumer pro	108
rationale, legitimacy	235	Consumer information, Labelling	101
international standards	228	Not specified	82
discrimination	177	Quality requirements	47
time to adapt, "reasonable interval"	142	Harmonization	26
non-product related processes and procedural methods	43	National security requirements	19
special and differential treatment	23	Protection of animal or plant life or health	16
technical assistance	8	Reducing trade barriers and facilitating trade	0
		Cost saving and productivity enhancement	0

Table 2.2: Number of TBT concerns by type and objectives

Chapter 3: Impact of deep PTAs on quality

3.1 Introduction

The role of quality as a determinant of trade patterns has been studied in the theoretical literature since [Linder, 1961], who argued that rich countries produce and consume higher quality goods than developing countries. His work led to the extensively tested prediction that countries of similar income per capita tend to trade more with each other, also known as the Linder hypothesis. Subsequent theoretical and empirical work has demonstrated the existence of both supply-side and demand-side relationships between countries' development level and the quality of traded goods.

The role of quality operating on the demand side is supported by the empirical work of [Hallak, 2006] who finds that rich countries tend to import more from counterparts producing goods of higher unit values. [Schott, 2004] and [Hummels and Klenow, 2005] provide evidence for the role of quality on the supply side, showing that quality (also measured with unit values) increases with exporters' income.

Beyond its role in determining trade patterns, quality upgrading has been linked to exporters' performance, adoption of new technologies, and to the rise

of income inequality in developing countries.[1] From a consumer or environmental welfare point of view, quality upgrading is beneficial for health and safety. The fundamental questions addressed by these studies include why product quality varies across countries and over time, and how it can be influenced by trade policy.

In the previous chapter, I highlighted the existence of two possible channels for quality adjustment following a TBT/SPS integration, the market size and regulatory channels. In this chapter, I rely on the theoretical model of chapter 2 to empirically estimate the impact of deep trade agreements on the quality of traded goods.

After deriving a measure of imported good quality at the industry level, I investigate the change in quality associated with PTAs that include TBT/SPS-related issues. Using the second version of the Content of PTAs dataset, I shed light on the role of TBT/SPS chapters in changing the quality of imported goods. I study the impact of different provisions that can be included in PTAs: mutual recognition and harmonization of standards, technical regulations, and conformity assessments of TBT measures; and mutual recognition and harmonization of standards, and inspection provisions of SPS measures. In each econometric specification, I control for the rest of PTAs content with a measure of total depth. Moreover, the literature shows that rich countries tend to trade products of higher quality. But rich countries are also most likely to sign deeper PTAs that include TBT/SPS provisions, which raises concerns on the endogeneity of such policies. I address this issue by controlling

[1] [Verhoogen, Eric A., 2008] finds that Mexican firms, which employed higher skilled workers and produced higher quality goods, performed better during the 1994 Peso crisis. [Bustos, 2011] sheds light on firms' incentive to innovate (and hence improve quality) following trade liberalization. [Goldberg and Pavcnik, 2007] shows that because of the changes in relative demand for skilled labor, quality improvement prompted by the demand from richer countries has been a determinant in the increase of income inequality in developing countries.

for country-pair fixed effects.

The empirical analysis shows that including TBT provisions in a PTA increases the quality of imports, with effects twice as large as when standards are mutually recognized rather than harmonized. Inclusion of SPS provisions also increases the quality of imports, but the distinction between mutual recognition and harmonization is less clear. The country-pair effects account for a large share of these impacts, which hints at the presence of policy endogeneity. Results are driven by PTAs between high- and low-income countries, supporting the importance for developing countries to tackle behind-the-border issues in their trade agreements. I also find that the estimated positive impacts of TBT/SPS provisions on quality are driven by products with a wider scope for quality improvement, such as differentiated goods.

3.2 Literature on quality estimation

Unless one is interested in studying a specific product for which quality attributes may be observable, comparable product qualities for a wide range of industries are usually difficult to measure directly. Example of quality-related attributes that can be observed are the efficiency of solar panels, i.e. how effectively they can convert solar radiation into electricity, or the sharpness of cameras' lenses, as measured by the index of Perceptual Megapixel. [Crozet et al., 2011] use wine terroir scores available for each producer in France as a proxy for wine quality and derive stylized facts regarding French exporters' performance in the wine sector. Unfortunately, finding consistent attributes for a large range of sectors and/or countries

is unfortunately not feasible. Nevertheless, a good measure of quality is necessary to feed the analysis of the present chapter. This section provides an overview of the techniques employed in the literature to measure quality for larger samples of products and countries and highlights their data requirements.

The common ground of all existing techniques is that quality is expensive to produce and higher costs are eventually passed through sale prices. Therefore, a natural attempt to measure quality is to resort to unit prices by assuming that higher sale prices reflect higher quality. At both the country and firm level, this solution is convenient because it only requires trade values and quantities. [Schott, 2004] and [Baldwin and Harrigan, 2011] compute unit values from product-level US import data and [Hummels and Klenow, 2005] use cross-section bilateral trade at the 6-digit level. These studies support the intuition that unit value increases with the GDP per capita of exporters and importers, and shed light on the role of quality in determining aggregate trade patterns. [Johnson, 2012] studies the link between export prices and price thresholds to access different markets. He uses cross-section bilateral trade data from the CEPII's BACI database and finds that higher trade unit values are associated with destination markets with higher entry thresholds.

Unit values computed with firm-level data allow researchers to test predictions from micro-founded theories. Using Chinese firm-level data, [Manova and Zhang, 2012] show that firms charging higher unit values export to more destinations. With Colombian data, [Kugler and Verhoogen, 2011] find that the best performing firms tend to use more expensive inputs and export higher unit value outputs. Also with Colombian data, [Brooks, 2006] highlights the role of product quality in explain-

ing why Colombian firms are found to under-export manufactured goods to the US. [Hallak and Sivadasan, 2013] confirm the positive relationship between export performance and output quality by using data from India, US, Chile and Colombia.

The major drawback of using export prices to infer quality is that unit values are also likely to reflect the cost of factors of production, which weakens the identification of quality from the variation of unit prices. To address this issue, researchers have developed ways to indirectly estimate quality, defined as a vertical characteristic that shifts consumers' utilities.[2] Many studies build on the straightforward intuition that after controlling for prices and horizontal characteristics, higher quality products should drive higher demand.

The estimation of import demand functions to derive quality has become standard in the most recent literature. In practice, import demand equations are estimated while accounting for the endogeneity of prices. Then the resulting price elasticities are used to compute quality from the relevant fixed effects and/or the demand residuals. The main challenge is to obtain consistent estimates of price elasticities. Researchers have turned towards instrumental variables strategies, using exchange rate related measures to instrument for prices. The variation used to identify demand parameters ultimately depends on the detail level of the data employed for the estimation. With product-level US data, [Khandelwal, 2010] estimates import shares controlling for unit prices and sectoral varieties to derive quality estimates based on the demand residuals. [Hallak and Schott, 2011] obtain

[2]The taste for quality is not to be confounded with the horizontal love of variety, which justifies why low quality products are still traded along higher quality products of same price.

quality estimates from the trade balances also conditional on export prices. On the firm-level side, [Khandelwal et al., 2013] use Chinese customs data, [Gervais, 2013] uses data from the US Census of Manufactures, and [Piveteau and Smagghue, 2019] use French customs data.

Overall, the scope and detail of the data, as well as the selected estimation strategy, ultimately depend on the research questions to be addressed. In this chapter, I am interested in evaluating the heterogenous impact of the content of TBT/SPS measures included in PTAs. Since I am studying the whole realm of PTAs enforced and notified to the WTO over a long time span, I need to derive time-varying quality measures for the largest set of countries possible. The level of product disaggregation will consequently be pinned down by the data availability. I choose to follow closely the methodology developed by [Khandelwal, 2010] after adjusting his demand equation with the one obtained from the preceding chapter.

3.3 Estimation of quality

In this section, I describe the methodology implemented to estimate the quality of imported goods at the origin-destination-product-year level. I follow the literature that estimates quality using the demand-side variation of trade, based on the following straightforward assumption: conditional on prices, higher demand for imports should reflect higher quality.

3.3.1 Demand for imports

Drawing on the model developed in chapter 2, I derive the aggregate demand for imports from the CES consumers' demand function (2.6) over all firms by using the Pareto distribution. I denote $\tilde{Z} = M_{ijs} \int_{\varphi^*}^{\infty} Z d\varphi$ the aggregated function of any variable Z that depends on the productivity level. For any constant H that does not depends on φ, the aggregation falls to $M_{ijst} H \int_{\varphi^*}^{\infty} \left(\frac{\varphi^*}{\varphi}\right)^{\theta} d\varphi = M_{ijst} H \frac{\varphi^*_{ijs}}{\theta_s - 1}$.

The aggregated log import demand of country j, for product s, from origin i, at time t is written as follows:

$$\widetilde{\ln x_{ijst}} = \underbrace{-\sigma_s \widetilde{\ln p_{ijst}}}_{(1)} + \ln \underbrace{M_{ijst}}_{(2)} \underbrace{\tilde{P}_{jst}^{\sigma_s - 1} \mu_{js} E_{jt}}_{(3)} \underbrace{\frac{\varphi^*_{ijs}}{\theta_s - 1}}_{(4)} + \underbrace{(\sigma_s - 1) \widetilde{\ln q_{ijst}}}_{(5)} \tag{3.1}$$

Where (1) is the unit price, whose elasticity is σ_s. The unit price is proxied by trade unit value obtained by dividing trade value over quantity at the HS 6-digit level, which is the most disaggregated level available for a large sample of countries; (2) represents the number of varieties within a product class s. This variety variable reflects the horizontal taste of consumers for a large choice of products. For sake of simplicity, I follow the literature and approximate this variable by either the population or GDP of the exporting country; (3) is composed of the quality-adjusted price index and aggregated income in the destination country. It does not depend on the origin country, so it can be accounted for by the use of product-destination-time (or variety-time) fixed effects; (4) will be accounted for by destination-sector-time and country-pair-sector fixed effects; lastly (5), conditional on prices and varieties,

the remaining term represents the quality of imported goods and can be retrieved from the residual demand denoted ϵ_{ijst} given the estimates of $\hat{\sigma}_s$. The instrumental variables would allow us to estimate the elasticities of substitution; alternatively these parameters can be conveniently taken from [Broda and Weinstein, 2006] at the HS 6-digit level.[3] I estimate the demand curve (3.1) for each HS 2-digit industry, and retrieve quality from the estimated residuals at the HS 6-digit level. Finally, I compute a trade weighted measure of quality at the 2-digit industry level using import shares as weights.

3.3.2 Dealing with price endogeneity

As explained in the literature review section, the main challenge entailed by the estimation of the import demand equation is the endogeneity of prices that might come from both simultaneity and measurement error problems. Indeed, since quality is costly to produce, the additional production costs dedicated to quality improvement are expected to be passed through to prices. Thus, unit values are likely correlated with the residual term, raising simultaneity concerns. Also, given that unit value is constructed as the ratio of trade flows over quantity, it is highly dependent on the level of aggregation and product classification, which makes it prone to measurement errors. Both sources of endogeneity are expected to bias downward the estimates of σ_s.

I do not identify σ_s in my estimation of import demand, instead I use the price

[3]Doing so includes additional noises to the estimates and should be addressed in further revisions.

elasticities that have been consistently identified by [Broda and Weinstein, 2006]. However, I still include an instrumental variable in my estimation of equation (3.1) to test for over-identification.[4] This instrument is constructed from the interaction of the bilateral nominal exchange rate (varying at the country-pair-time level) and a proxy for transportation costs (varying at the industry level):

$$XrateTransportIV_{ijst} = \frac{e_{LUC_{it/\$}}}{e_{LUC_{jt/\$}}} \times CIF_s/FOB_s \tag{3.2}$$

Where $e_{LUC_{kt/\$}}$ are the nominal exchange rates of country k's local currency against the USD, CIF is the cost, insurance and freight price, and FOB is the free on board price averaged at the HS 2-digit industry level.

The use of an instrument derived from exchange rates is frequent in the literature that estimates quality (see [Khandelwal, 2010], [Hallak and Schott, 2011], and [Piveteau and Smagghue, 2019]). As pointed out by [Piveteau and Smagghue, 2019], this choice may be questionable if one believes that goods imported from countries with stronger currencies have higher quality. There would be a positive relationship between quality and the exchange rate at the cross-section level. However, at least in the short/medium run, firms are not expected to quickly react to changes in exchange rates by upgrading the quality of their exports following an importer devaluation of an importers' currency. Therefore, despite existing cross-section variations in the exchange rate pass-through into import prices across sectors, product characteristics, or currencies of invoicing, time varying exchange rates seem

[4] If σ_s from [Broda and Weinstein, 2006] are correctly identified, one should find a coefficient of -1 for the variable unit price multiplied by $sigma_s$.

to be a good candidate to instrument for prices in the import demand equation.

To add industry-level variation to the instrument, I then interact the exchange rate with a proxy for transportation costs. Databases with large coverage of bilateral trade flows usually do not provide widespread measures of bilateral transportation costs.[5] The usual way to circumvent this limitation is to use the mirror nature of trade data. In a perfect world, each trade flow should be reported twice, once by the importing economy and once by the exporting one. On the one hand, importers declare CIF flows, and on the other hand exporters report FOB trade flows. Therefore, the ratio CIF/FOB can give us a proxy for unit transportation/insurance costs at the industry level. Transportation costs satisfy the relevance condition with no objection, but there might be concerns about the exclusion restriction. Quality might be correlated with distance (hence higher transportation costs) as supported by [Hummels and Skiba, 2004] who investigate the "Washington Apples" effect in which higher quality goods may be exported to more distant countries in order to lower the unit transportation costs.

To address this concern, [Khandelwal, 2010] argues that "as long as transportation costs do not affect deviations from average quality the instrument remains valid" because the Washington Apples effect is identified using cross-section variations rather than variation in transportation costs over time. To summarize, the estimation of quality relies on the following specification, estimated with OLS for

[5]Unlike the US official trade data which provides transportation cost at the most disaggregated level, a measure used by [Khandelwal, 2010]

each of 94 HS 2-digit industries:

$$\begin{aligned}
\widetilde{\ln x_{ijst}} =& \beta_1 \widetilde{\ln p_{ijst}} + \beta_2 \ln pop_{it} + \alpha_{jst} + \alpha_{ijs} + \epsilon_{ijst} \\
\ln p_{ijst} =& \gamma XrateTransportIV_{ijst} + a_{jst} + a_{ijs} + \nu_{ijst} \\
\Rightarrow \widehat{\widetilde{\ln q_{ijst}}} =& \frac{\epsilon_{ijst}}{\sigma_s - 1}
\end{aligned} \tag{3.3}$$

Results of the quality estimations are reported in the subsequent sections.

3.3.3 Impact of TBT/SPS provisions on quality

I use the quality estimates from (3.3) to assess the impact of TBT/SPS provisions included in PTAs on imported good quality. Below, I recall the equations for aggregated quality derived in the second chapter (2.16) and (2.17):

$$\tilde{q}_{ijs}^{NR} = \Upsilon_s b_{is}^{\theta_s} \underbrace{M_{is}^e \left[\Gamma_{ijs}\right]^{\frac{\theta_s}{\sigma_s - 1}}}_{A_{NR}} \underbrace{\left(\underline{q}_{js}\right)^{1-\theta_s \frac{1-\psi_s(\sigma_s-1)}{\psi_s(\sigma_s-1)}}}_{B_{NR}} \underbrace{\left(1 + \frac{F_{ijs}^{\psi_s}}{\underline{q}_{js}}\right)^{\frac{1}{\psi_s(\sigma_s-1)}}}_{C_{NR}}$$

$$\tilde{q}_{ijs}^{MR} = \Upsilon_s b_{is}^{\theta_s} \underbrace{M_{is}^e \left[\sum_j \Gamma_{ijs}\right]^{\frac{\theta_s}{\sigma_s - 1}}}_{A_{MR/HR}} \underbrace{\left(\underline{q}_{is}\right)^{1-\theta_s \frac{1-\psi_s(\sigma_s-1)}{\psi_s(\sigma_s-1)}}}_{B_{MR/HR}} \underbrace{\left(1 + \frac{\sum_{\{j \in PTA_{ijs}\}} F_{ijs}^{\psi_s}}{\underline{q}_s}\right)^{\frac{1}{\psi_s(\sigma_s-1)}}}_{C_{MR/HR}}$$

Where $\Gamma_{ijs} = \frac{\psi_s(\sigma_s-1)}{\sigma_s} \left(\frac{\sigma_s}{\sigma_s - 1} \frac{t_{ijs}\tau_{ijs}w_i}{\tilde{P}_{js}}\right)^{1-\sigma_s} \frac{\mu_{js}E_j}{w_i t_{ijs}}$. The change in the functional form of quality moving from $\tilde{q}_{ijs}^{NR}$ to $\tilde{q}_{ijs}^{MR}$ sheds light on the two main motives for quality improvement. I refer to the change from A to $A_{MR/HR}$ as the market size channel. It shows that the reduction of trade barriers enabled by the enforcement of a PTA implies an increase in market access (sum of Γ's), which triggers competitively mo-

tivated quality improvements to capture bigger market shares abroad. The number of domestic firms M_{is}^e will eventually change due to the general equilibrium effects, which increases competition at home too. Together these two terms only depend on the origin country j and can be taken care of with destination-time fixed effects.

On the other hand, the change from B to $B_{MR/HR}$ corresponds to the regulatory channel. In an integration associated with mutual recognition, the change in the ex-post minimum quality requirements (induced by the option to seek the least expensive TBT/SPS measures) explains how TBT/SPS-related chapters in PTAs can impact quality. Basically, mutual recognition allows firms to minimize the costs related to TBT/SPS measures either by saving on redundant foreign costs, or by getting access to cheaper requirements. The new generation of PTAs has often faced strong backlash from public opinion, which fears that integration to larger markets might level down standards and undermine countries' sovereignty in setting their domestic legislation. In response to voters' pressure (and probably to lobbies too), we increasingly observe provisions granting exceptions to sensitive sectors in the content of PTAs. Nevertheless, when integration occurs between parties at different levels of development, the least developed partners are virtually always required to raise their standards, sometimes in the context of a pre-accession agreement (as is the case for each EU enlargement).

The above partial equilibrium equations can also help predict the effect of harmonization on quality. Policy makers claim that the harmonization approach to integrating TBT/SPS measures is the most conservative one, as regulations should be raised to the most stringent level possible. Under that condition, the regulation

channel should have a positive direct impact on quality by raising $\underline{q}$, at least for the economy that must adjust its regulation to be in line with the higher standards. Finally the change from C to $C_{MR/HR}$ combines the two channels above but will be captured by country-pair and sector fixed effects.

To test these predictions, I first estimate the following baseline equation with OLS:

$$\ln \hat{Q}_{ijst} = \beta_1 Provision_{ijt}^{TBTSPS} + \beta Depth_{ijt} + a_{it} + a_{jt} + a_{ij} + a_{st} + \mu_{ijst} \qquad (3.4)$$

The way I code the content of PTAs is explained in detail in the next section. In a nutshell, the independent variables included in (3.4) describe the extent to which a PTA addresses various policy areas, and in particular TBT/SPS-related policies. The main variable of interest is $Provision_{ijt}^{TBTSPS}$, which is a dummy that indicates whether and how TBT or SPS measures are addressed when a PTA is signed between countries i and j. The list of provisions is indicated in Tables (A.3) and (A.4). If the provision is addressed in a PTA, the variable turns on and stays at one from the date of enforcement. The variable $Depth_{ijt}$ is defined as the sum of 50 dummy variables that indicate the presence of the main policy areas in PTAs other than TBT or SPS-related areas (see Tables (A.1) and (A.2) for the other possible areas included in PTAs). This allows me to control for the horizontal scope of trade agreements in areas other than reduction of tariff barriers and TBT/SPS issues. The directional fixed effects a_{it} and a_{jt} control for country-level determinants of quality, such as market size. The pair fixed effects a_{ij} capture traditional gravity-

like variables (such as common language, distance and common borders) that may affect the level of quality traded between a pair of countries. Finally, a_{st} captures the evolution of innovation within an industry s.

Next, I investigate heterogeneity of the results by interacting the TBT/SPS provisions with first country-level and then sector-level variables. The model predicts that quality should change more if the prior difference between parties' regulations is larger.

To test this hypothesis, I first use dummy variables indicating the difference in development level between the parties. I create three variables identifying trade relationships between Northern and Southern countries. The variables are denoted NN when trade occurs between two high-income countries, NS for trade between a high-income country and a low- or middle-income country, and SS for trade between two developing countries. The level of income is based on the World Bank's classification of development. The corresponding econometric specification is:

$$\begin{aligned}\ln \hat{Q}_{ijst} =& \beta_{NN} Provision_{ijt}^{TBTSPS} \times NN_{ij} \\ &+ \beta_{NS} Provision_{ijt}^{TBTSPS} \times NS_{ij} \\ &+ \beta_{SS} Provision_{ijt}^{TBTSPS} \times NS_{ij} \\ &+ \beta_2 Depth_{ijt} + a_{it} + a_{jt} + a_{ij} + a_{st} + \mu_{ijst}\end{aligned} \tag{3.5}$$

I use the intensity of ISO 9001 certification as a proxy for the overall level of existing quality at the country-sector level. To account for the potential bias induced by large differences in the number of firms across countries, I divide the

number of ISO certifications by each country's total export.[6] Finally, I compute the intensity gap (or difference in intensity gap) between parties and denote it as ISO_{ij}^{9001}. The resulting specification is:

$$\begin{aligned}\ln \hat{Q}_{ijst} =& \beta_1 Provision_{ijt}^{TBTSPS} + \beta_2 Provision_{ijt}^{TBTSPS} \times ISO_{ijs}^{9001} \\ &+ \beta_3 Depth_{ijt} + a_{it} + a_{jt} + a_{ij} + a_{st} + \mu_{ijst}\end{aligned} \tag{3.6}$$

Finally, I interact the TBT/SPS provision with a variety-level measure of product differentiation (where a variety is defined as an origin-product pair). Products differ in their level of complexity, which implies that the potential range of quality variation might not be the same for homogenous versus highly differentiated products, or for countries in which the technology level is high or low. I motivate my investigation of this type of heterogeneity with the work of [Khandelwal, 2010], who defines a measure of scope for quality differentiation or "quality ladders" at the product level. In his paper, the ladders are defined as the range of quality within HS 10-digit products and across all origin countries. I follow his method by testing three measures of ladders: the full range, the inter-decile range, and the interquartile range, whose the last two measures should be more robust to outliers than the first measure. Since I am ultimately working with bilateral measures of quality, I construct the ladders at the HS 6-digit level, my finest level of observation.

$$Ladder_{iht} = pctile^{top}(\hat{quality}_{iht}) - pctile^{bottom}(\hat{quality}_{iht}) \tag{3.7}$$

[6] Dividing the ISO certifications by the number of firms in a country, drastically reduces the number of observations.

where $pctile^{top}$ is either max, 90^{th} or 75^{th} percentile, and $pctile^{bottom}$ is min, 10^{th} or 25^{th} percentiles. Then, I take the trade weighted average of $Ladder$s to obtain an industry-level aggregated measure of the quality range at the 2-digit level.

$$IndLadder_{ist} = \sum_{h \in s} w_{iht} Ladder_{iht} \tag{3.8}$$

Finally, I include the interaction term between TBT/SPS provisions and the industry level ladders to obtain the following specification:

$$\begin{aligned} \ln \hat{Q}_{ijst} =& \beta_1 Provision_{ijt}^{TBTSPS} + \beta_2 Provision_{ijt}^{TBTSPS} \times IndLadder_{ist} \\ &+ \beta_3 Ladder_{ist} + \beta_4 Depth_{ijt} + a_{it} + a_{jt} + a_{ij} + a_{st} + \mu_{ijst} \end{aligned} \tag{3.9}$$

I expect the coefficient β_2 to be positive, revealing that sectors with more scope for quality improvement will experience a higher increase in quality following mutual recognition or harmonization of TBT/SPS measures.

To understand the determinants of the quality ladders, I use the definition of optimal quality (3.3) and derive an expression for the ladder's lower bound. If one assumes that firms from developed countries have access to better technology than their developing country competitors ($b_{Ns} > b_{Ss}$ from the Pareto minimum productivity parameters), then I can compute $\log(q_{Njst}^{opt}) - \log(q_{Sjst}^{opt})$, where optimal quality for the developed country firms is evaluated at the minimum productivity b_{Ns}. It is reasonable to think that over the whole set of developed countries at least one will be associated with a minimum productivity parameter that enables firms to easily pass the tests for minimum quality certification. Conversely, over the

whole set of developing countries at least one will be associated with a minimum productivity parameter that does not allow a firm to pass these tests. Therefore to get the ladder's lower bound, $\log(q^{opt}_{Sjst})$ is evaluated at the productivity threshold φ^* that allows firms to fulfill minimum quality certifications.

$$\begin{aligned}\log(q^{opt}_{Njst}) - \log(q^{opt}_{Sjst}) = &\frac{\psi_s}{1-\psi_s(\sigma_s-1)}\left[-\sigma_s \log\left(\frac{t_{Njst}w_N}{t_{Sjst}w_S}\right)\right. \\ &\left. + (1-\sigma_s)\log\left(\frac{\tau_{Njst}}{\tau_{Sjst}}\right) + (\sigma_s-1)\log\left(\frac{b_{Ns}}{\varphi^*_{Sjst}}\right)\right]\end{aligned} \tag{3.10}$$

Equation (3.10) shows that the ladder intuitively lengthens with the level of technology in the developed countries. All else equal (same wages, same tariffs and iceberg trade costs) longer ladders are associated with higher σ_s, or in other words with more differentiated goods. Moreover, similar to [Khandelwal, 2010] the ladders can be indexed by the valuation parameter ψ_s, so that industries with higher valuation for quality certification are associated with longer ladders.

3.4 Data

In this section, I first describe the data employed to estimate quality and its derived ladders. Then, I present in detail the novel data used to identify the change in trade policies related to TBT and SPS measures. I complete the data section with a presentation of the survey data on ISO certification and a brief description of the Specific Trade Concerns data.

3.4.1 Data for the quality estimation

For the estimation of product quality, I use bilateral import data from the Base pour l'Analyse du Commerce International (BACI) database developed by CEPII, which provides import values and quantities at the 6-digit product level between 1995 and 2015. The CEPII applies the procedure described in [Gaulier and Zignago, 2010] to the underlying UN-Comtrade bilateral trade data in order to reconcile the declarations to the United Nation Statistics Division of almost 200 exporting and importing countries. Normally, each flow should be reported twice to the United Nations Statistics Division, once from the exporter and once from the importer. The first exercise aims to verify the consistency of this mirror reporting. Then the procedure draws on this same principle of mirror declarations of trade flows to fill in information that is not reported (when only one of the two partners reports a trade flow).

In a first step, the CEPII procedure transforms the reported CIF import values as FOB, in order to match import with FOB export declarations. The transformation removes the transport costs. However, unlike the US customs data for example, product level transportation costs are not reported. The transformation from CIF to FOB needs to be estimated using a gravity-like model including the usual CEPII gravity variables (share of border, landlocked country, same language, colonial ties), year fixed effects and product level median unit-values. Then, the import-export FOB mirror values are averaged at the product country-pair level. For obvious capacity and technical reasons, reports from low-income countries such as Malawi

are not as reliable as those from the US. To account for the potential difference in reporting accuracy, the CEPII applies a "reliability" weight to compute the average import-export FOB values. Those weights are based on the geographical and sectoral specialization of the reporting countries. Overall, this mirror data procedure has two advantages, it allows CEPII to extend the coverage of the available data and increases the reliability of the data reported by low income countries.

As explained in the previous section, the import demand equation is endogenous in prices. To compute the instrumental variable for the unit values, I use the CIF/FOB ratios to proxy for transportation costs. These ratios are also taken from CEPII and benefit from the same methodology relying on mirror data to fill in missing prices. Finally, nominal exchange rates, GDP and population variables are taken from the World Development Indicators dataset. The elasticities of substitution are taken from [Broda and Weinstein, 2006].

3.4.2 Data on TBT/SPS chapter

I use the new dataset on the vertical Content of PTAs developed by the World Bank to identify what kind of TBT/SPS measures are included in PTAs.[7]

As mentioned in the introductory chapter, the dataset is the result of a second round of research on the content of PTAs. In a first round, the contents of 260 PTAs notified to the WTO (as of 2015) were mapped across 52 policy areas. Legal experts in charge of the mapping classified the policy areas between two categories with respect to the WTO's mandate. The nature of the first mapping could be described

[7]See [Espitia et al., 2019] for a complete description on the TBT chapter

as horizontal, in the sense that it is limited to the general question "does the trade agreement include a chapter on "xyz" area?". It provides information on the breadth of an agreement and the legal enforceability of area-specific commitments.

The second mapping was undertaken to go deeper into the details of specific policy areas, extending the original 52 degrees of freedom into more than 1000 provisions. In this chapter, I use this "vertical" mapping of the TBT and SPS chapters in order to identify their mode of integration. The TBT mapping covers the 255 PTAs that entered into force between 1960 and 2017 and included TBT provisions. The template of the TBT mapping reported in Table (A.3) was first developed by [Budetta and Piermartini, 2009], who originally focused on PTAs signed by the EU, the US and Mexico. The first set of provisions indicates whether an agreement refers to the WTO's TBT Agreement and whether it goes beyond the commitments taken under the WTO in terms of new areas covered or sector-specific engagements.[8] The next three sets of provisions indicate the type of integration approach — mutual recognition versus three modes of harmonization — adopted or promoted for standards, technical regulations and conformity assessment procedures. The last set of provisions describes the modalities of implementation, notably the way disputes

[8]The TBT Agreement calls for WTO members to use existing international standards as a basis for their technical regulations. It encourages countries to accept as equivalent the technical regulations of other Members if these regulations adequately fulfill the objectives of their own domestic regulations (TBT Agreement, Article 2.7). Its Article 6 supports mutual recognition agreements that recognize the tests and certifications of another country independently. It requires transparency of new technical regulation, by expecting members to publish and notify the WTO Secretariat (Article 2.9) and to make available inquiry point (Article 10). Under Article 11, members are expected to provide technical assistance to other WTO members for compliance with TBT measures. Article 14 refers to the Dispute Settlement Body for consultations on TBT matters, and finally the TBT Agreement establishes the Committee on TBT (Article 13) to deal with the administration of the Agreement, which will later on be mandated to analyze Specific Trade Concerns raised by members on matters related to trade protection and TBT measures.

shall be handled, the transparency of measures, the cooperation and technical assistance offered to/by the signatories. I focus on the provisions describing the type of integration, making the distinction between mutual recognition and harmonization. I look at the impact of different provisions related to standards, technical regulations and conformity assessment one at the time, but ultimately I combine those three measures to create two composite indices, one for mutual recognition and one for harmonization.

The SPS mapping covers 283 PTAs signed through 2016 and builds on the work of [Jackson and Vitikata, 2016] as well as [Budetta and Piermartini, 2009]. It is organized in a similar way as the TBT mapping, with a first section asking whether the PTA refers to the WTO mandate.[9] Then there are three sections on standards, risk assessment, and inspection, distinguishing between mutual recognition and harmonization (to specific, regional or international rules). Finally, the mapping is completed with provisions related to transparency, institutions and other areas of cooperation. I also look at the individual impacts of SPS provisions one at the time, before eventually moving to the creation of two indices that distinguish between mutual recognition and harmonization. Table (A.4) shows the complete list of questions coded for the SPS chapters.

The mapping of all TBT and SPS questions also records the degree of enforceability of the provisions. The lowest degree of enforceability is assigned when treaties simply address a provision by using non-binding legal language (with words such as

[9]Similar to its TBT counterpart, the SPS Agreement states the rights and obligations of WTO members (Article 2), the recommendations relative to Harmonization (Article 3), Equivalence (Article 4), Risk assessment (Article 5), Transparency (Article 7), technical assistance (Article 9), Dispute Settlement (Article 11) and the creation of the Administration SPS committee.

"may", "should", etc). If parties expressed the desire to commit or encourage the implementation of a provision without resorting to a dispute settlement mechanism, the level of enforceability is considered average. And finally, the highest level of enforceability refers to cases in which a provision is introduced with legal obligation or clear ways of undertaking actions, notably with the creation of a dispute settlement mechanism. For my analysis, I follow previous works in this domain and focus on provisions that are at the minimum binding, arguing that weak enforceability does not reflect a genuine commitment from the signatories.

The TBT and SPS chapters have been mapped to 34 and 59 provisions respectively. Therefore for the sake of clarity, I first group the individual provisions by their mode of integration, meaning either mutual recognition or harmonization. I create $TBT_{all}^{MutualReco}$ and TBT_{all}^{Harmo} to indicate whether the agreement includes any provisions related to the mutual recognition or harmonization of TBT measures, so these variables are 0/1 dummies. The same is done for the SPS measures. Specifically, i) $TBT_{all}^{MutualReco} = 1$ if any of the questions "Is mutual recognition in force?" for Standards, Technical Regulations, or Conformity Assessment are true. ii) $TBT_{all}^{Harmo} = 1$ if any of the questions "Are there specified existing standards to which countries shall harmonize?", " Is the use or creation of regional standards promoted?", "Is the use of international standards promoted?", or "Do parties participate in international or regional accreditation agencies?" also for Standards, Technical Regulations, or Conformity Assessment are true. iii) $SPS_{all}^{MutualReco} = 1$ if "Standards — Is equivalence recognized?", "Standards — Is mutual recognition recognized?" or "Audits/Control inspection — Is mutual recognition in force?" is

true. iv) Finally, $SPS_{all}^{Harmo} = 1$ if any of "Standards: - Do parties reference international standards?", "Standards: - Do parties recognize the adaption to regional conditions?", "Standards & Inspection — Are there specified existing standards to which countries shall harmonize?", "Standards& Inspection — Is the creation of concerted/regional standards referenced?", or "Inspection — Is the use of international standards promoted?" is true.

Next, I look at more disaggregated indices, but still focus on the mode of liberalization (i.e. mutual recognition versus harmonization). I distinguish Standards, Conformity Assessment and Technical Regulation related provisions of TBT measures, and Standards or Audit/Inspection related provisions of SPS measures. When several provisions relate to one of the above categories, I create an index reflecting the presence of "any" relevant provisions. For example, the $TBT_{Standard}^{Harmo}$ index is a 0/1 dummy if any of the following provisions is true: "Standards — Are there specified existing standards to which countries shall harmonize?", "Standards — Is the use or creation of regional standards promoted?", or " Standards — Is the use of international standards promoted?".

3.4.3 ISO survey

In specification (3.6) I interact the TBT/SPS provisions with the ISO 9001 certifications gap between trading partners (relative to each partner's total exports). The purpose of this variable is to measure how distant countries are in terms of quality-related best practice. Despite being disconnected from the ultimate goals

of TBT/SPS measures, the ISO 9001 standards family is a useful tool to gauge the level of a company or organization's commitment towards "quality management".

The ISO 9001 standard requires organizations to set out their objectives regarding the improvement of their quality management system. It helps businesses and organizations to be more efficient and improve customer satisfaction. As an example: the Sénégalaise Des Eaux (SDE), which supplies drinking water to five million citizens, has been using ISO 9001 since 2002. The standard helps the organization to anticipate and meet the needs of its customers, as well as ensuring the quality of the water and services. An example of customers' need is an improved facility of payment. To satisfy this need, the SDE is diversifying its payment methods by offering mobile phone service. The advantage of using information on the ISO 9001 standard family is that it can be adopted by any entity from the private or public sector, regardless of its activity. It is a widespread standard adopted by more than one million companies across the world and has the advantage of being certifiable. Certification allows to track the incidence of ISO 9001 standards across countries and industries.

Every year ISO carries out a global survey to collect the number of newly granted ISO 9001 certificates. Since the ISO does not perform certification itself, it relies on the responses of accredited certification bodies reporting the number of ISO standards granted. The ISO acknowledges that the fluctuations in the number of certificates from year to year should be interpreted cautiously, because of uncontrolled variations in the number of participating certification bodies. For this reason, I collapse the data at the country-industry level and use the average number

of certifications across the surveyed period 2009-2014. The ISO survey is reported at the SITC 2-digit level, which I map to the HS 2-digit classification. Certifications have been reported by entities from 183 countries. Figure (3.4) shows large heterogeneity in certifications across sectors. More homogenous sectors, such as animal and animal products, do not seek the quality management certification as much as more complex sectors, such as transportation. This does not mean that the sectors that do not seek ISO certifications are not concerned with quality, but simply reveals that the chosen ISO measure has limitations and another quality index should be used for those less differentiated sectors.

3.4.4 Specific trade concerns

Finally, I use data on the TBT and SPS Specific Trade Concerns (STCs) notified to the WTO to identify the sectors for which TBT and SPS measures have the largest incidence.[10] The STCs database publishes the information reported to the two special SPS and TBT committees established within the WTO. The purpose of these committees is to provide member countries a "forum for exchange of information on all aspects related to the implementation of the SPS and TBT Agreements". If one country estimates that a trading partner is imposing unfair SPS/TBT measures that have a significant effect on trade, it can raise its concern to one of the two committees and report which country is imposing the new SPS/TBT measure, the affected products, and how it affects trade. The WTO publishes

[10] [Fontagné et al., 2015] use the STC database to shed light on the effect of non-tariff barriers on trade, [Orefice, 2017] looks at the positive relationship between tariff reduction and TBT/SPS measures increase.

all this information in two SPS and TBT STCs databases, which report: 1) the country or countries raising the concern and the country imposing the measure, 2) the HS 4-digit product of concern, 3) the year the concern was raised (data available between 1995 and 2011), 4) whether the concern has been resolved, and 5) the reason for the concern (quality requirements, protection of the environment, harmonization, consumer information, etc.) The STC data helps me establish that all sectors are exposed to the TBT measures, but SPS measures only apply to the Animal, Vegetable, Food and related products sectors.

3.5 Results

In this section, I first present the results from the estimation of quality and quality ladders and show that the estimates verify the general findings on quality from the literature. Then I move to the estimation of the effects of TBT and SPS measures on the estimated qualities and test for potential sources of heterogeneity in their effects.

3.5.1 Quality estimates

Quality is estimated after running 94 separate econometric specifications (3.3) corresponding to each HS 2-digit industry. The identification of the price coefficient comes from the origin-destination-6-digit-product variation within a 2-digit industry. The resulting quality estimates are available at the HS 6-digit product level, but are eventually aggregated to the 2-digit industry level using import share weights.

Ultimately, I decided to work with an industry-level measure of quality in order to identify potential heterogeneity in the impact of TBT/SPS measures, which are only observable at this broader level of classification. The summary statistics from the econometric specifications are reported in table (3.2). The comparison of the price coefficients between the OLS and the IV estimations shows how accounting for the problem of endogeneity improve the sign and magnitude of the unit price coefficient. The $F-stats$ of the first stage are large, confirming the relevance of instruments for the price variable. the $R-squared$ and $F-stat$ of the quality equation also confirm the validity of the estimations.

The inferred qualities are regressed on different proxies for countries' development level: GDP per capita, the capital-labor ratio, and the share of population with high education. The results, reported in table (3.3), show that developed countries (with higher GDP per capita, higher capita-labor ratios and higher education attainment) export higher quality products relative to developing countries, which is in line with the findings in the literature. Results are robust to the variables (population versus GDP) used in the import demand equation to control for the number of varieties produced in the exporting countries. In the rest of this chapter, I present the results using the measure of quality that was obtained from the specifications using population as a control variable for the number of varieties, but the main findings remain the same with the alternative GDP control.

In a second step, I construct the HS 6-digit quality ladders based on the formula (3.7) applied to log qualities. For a given product, the ladder is a proxy of the scope for quality improvement available to firms. I remove outliers that

could distort the ladders by computing the interdecile and interquartile ranges. I then aggregate the product ladders at the HS 2-digit industry level using import shares as in (3.8). Figure (3.2) shows that the lengths of the industry ladders are more or less constant over time for a given industry, at least within the relatively short time span available, during which we would not observe frequent and major technological progresses. Statistics on the dispersion, maximum, minimum and median also confirm the stability of industry ladders over time.

Moreover, the figure displays the distribution of scopes for quality improvement across industries. Intuitively, the prepared foods, mineral products and vegetable products industries have the shortest ladders, while transportation and raw hides have the longest. This ranking also emerged from the elasticities of substitution, with long ladders corresponding to more differentiated goods with small elasticities of substitution, and short ladders corresponding to less differentiated goods that are easier to substitute and present smaller margins for quality differentiation.[11] Another comparison of the long versus short ladder can be done with respect to [Rauch, 1999] classification of differentiated products. Figure (3.3) show the correspondence between the Rauch's and HS classifications. The underlying correspondence is established at the HS 6-digit, but in the chart I display the proportion of homogeneous/differentiated in each broad HS categories. Long ladder categories overlap with the differentiated Rauch's category quite well, comforting the interpretation of sectors with longer ladder to be more differentiated.

As a last test on the estimates for quality, I run a similar regression of unit

[11] But would have expected machinery and electrical goods to be associated with a longer ladder.

values on quality as in [Khandelwal, 2010] to assess the relationship between prices and qualities. If prices were the best proxy for product quality, one would observe a positive correlation between them. Khandelwal argues that this would be the case if products only possess vertical (quality) attributes. However, in the presence of horizontal (taste/variety) attributes, the relationship may reverse and may vary with the length of the ladders. I ran the following specification:

$$\log(p_{ijst}) = \beta_1 \log(\hat{q}_{ijst}) + \beta_2 \log(\hat{q}_{ijst}) \times \log(IndustryLadder_{ijht}) + \alpha_{ht} + \epsilon_{ijst} \quad (3.11)$$

where p_{ijst} is the unit value at the product level, $\hat{q}_{ijst}$ is the estimated quality from the previous stage, $IndustryLadder_{ijht}$ is the corresponding scope for quality improvement, and α_{ht} are the product-time fixed effects. The results, reported in table (3.4), indicate a very small but positive and significant coefficient β_2. This means that the unit prices of products associated with longer ladders are more correlated with quality than for products with short ladders. In other words, the quality of more differentiated goods may be approximated by unit prices (even though the relationship is weak), but the quality of homogeneous goods is poorly identified by unit prices. The last remark is on the negative sign of the coefficient associated with quality. In the present study, quality is inferred from prices but conditional on the demand for imports. As import demand and prices are negatively correlated, so are estimated quality and prices.

3.5.2 Baseline effect of TBT/SPS measures on quality

Using the inferred measure of quality, I can estimate the change in quality following the entry into force of a PTA that includes TBT and SPS measures. Quality is aggregated at the country-pair by year by 2-digit industry level using trade shares as weights. The first set of results are based on the baseline specification (3.4).

The results for the baseline specification raise the importance of including country-pair fixed effects to account for bilateral characteristics that might determine the quality of goods traded between countries, such as historical or cultural ties, distance[12], or common language. Table (3.6) shows that, out of the four aggregated indices of interest, only the effect of mutual recognition of SPS measures "survives" the inclusion of country-pair fixed effects. The other variables are significant and positive before controlling for pair fixed effects, but are not significant afterwards. This sheds light on the presence of policy endogeneity explained by the fact that rich countries (which import and export high quality products) are likely to spread their own TBT/SPS regulations through PTAs negotiated with their main trading partners. The control variable $TotalDepth$ is significant and positive. Since its definition does not depend on the presence of TBT or SPS chapters in PTA, this coefficient reflects the remaining effect of the content of a PTA going beyond the chapters related to TBT and SPS measures. While the improvement of the overall institutional environment seems to positively affect quality, provisions other than TBT/SPS are not directly targeting issues on health and safety, and therefore shall

[12] cf. The Washington Apple effect, countries ship higher quality goods to long distance destination in order to reap for the cost of shipping

raise less endogeneity concerns for quality.

I then look at the disaggregated indices. Results for the TBT-related provisions, presented in table (3.7), suggest that the choice of integration approach is important to the impact on quality. Choosing mutual recognition (for any of the standards, technical regulation, or conformity assessment categories) increases quality by twice as much as the harmonization approach. One explanation might be that harmonization actually entails adaptation costs to new regulations, and resources involved to comply with the new regulations cannot be invested into quality improvement (at least in the aftermath of the regulatory change).

The coefficient on provisions captures the combined effect of increased market access and change in minimum quality regulation. [13] The reported coefficients tell us that a mutual recognition of TBT standards increases quality by 22 percent. The distributions of quality estimates reported for each sector in table (3.5) reveal that a 20 percent impact will not change dramatically the level of quality.[14]

Moving to the SPS results, table (3.8) indicates that the positive and significant relationship between quality and mutual recognition is driven by the provision on inspections. Surprisingly, the comparison between mutual recognition and harmonization is reversed, as harmonization seems to increase quality more than

[13]Results reported in appendix tables (A.5) and (A.6) show that between 35 and 40 percent of the overall impact of TBT/SPS provisions can be account for by sectoral composition.

[14]Because quality is an abstract measure is it also pertinent to relate this result to the comparison of export quality across countries. In 2003, Australia and Singapore signed a trade agreement and committed to mutually recognize their standards and technical regulations on TBTs. On average, the agreement is expected to have increased the quality of goods exported from Singapore to Australia by about 20 percent. As an illustration, in the inferred data this corresponds to an increase in quality of electrical machines or paper and paper products to the level of Israel, or an increase in the quality of headgear to the level of New Zealand.

mutual recognition on average. Sectors concerned with SPS measures tend to be more sensitive and protected by governments than those concerned with TBT measures, and they also tend to be more homogenous. Therefore, the scope for vertical differentiation is more limited.

3.5.3 Interaction with level of development

In the next three sections, I investigate the heterogeneity of the relationships between TBT or SPS provisions and quality. First, I look at differences across countries' level of development. I define as "northern" all countries classified as high income in the World Bank's WDI database. The "southern" category comprises all other income levels from upper-middle to low-income. I create three dummies (North-North, North-South and South-South) to identify the trading relationships between developed and developing countries. Results from the econometric specification 3.5 are reported in tables (3.9) and (3.10).

Mutual recognition of TBT measures tends to improve the quality of traded goods involving a developing country. Mutual recognition is easier to implement than harmonization and it is therefore not surprising that low income countries would benefit from it. The negative sign of the coefficient on the interaction between developed countries is more difficult to interpret. One would need to investigate further whether the increased competition from low productivity firms is driving this result. The third and fourth columns of table (3.9) show that the positive relationship between harmonization of TBT measures and quality is driven by North-

South trade. This is where the institutional gap is the biggest and is actually where most of the PTAs including a harmonization approach are signed. Minimum standards are expected to strengthen in developing countries, leading to a significant and positive regulatory channel (confirmed by the results reported in column (4)). As expected, harmonization does not have an impact on quality of imports between developed countries because "standards" are already high for all partners.

The results for the interaction between SPS measures and the level of development are less striking. Only the mutual recognition of SPS measures between developed and developing countries appears positive and significant in table (3.10), while all remaining coefficients are insignificant. The decomposition of SPS indices does not improve the results either. Perhaps the relevant heterogeneity does not fully reside in the difference of development levels, but rather in the sectoral composition. This is investigated in the next section.

3.5.4 Interaction with ISO 9001

I present the second exercise to investigate the heterogeneity of the effects of TBT and SPS measures on quality. I interact the integration approach indices with the gap of ISO 9001 certifications between trading partners as indicated in equation 3.6. The ISO gap is computed as the difference between the number of firms' certifications for this well-known quality management standard over time. Before taking the difference, the number of certifications is first scaled to the country's total exports, to account for the fact that larger markets may have more firms and

therefore more chances to appear in the ISO 9001 certifications survey. The resulting variable is then aggregated at the country-pair-industry level. Thanks to its large country coverage and multi-sector availability, this variable provides a useful proxy for how quality is valued by firms residing in each market.

Table (3.11) shows the results from including these interactions with TBT and SPS aggregated indices. Large gaps in quality management certification do not seem to matter for TBT provisions (whichever integration approach is implemented). SPS provisions have a negative impact on quality for sectors with the larger gap of quality management certification. These results give a hint on underlying sectoral differences. Focusing on the sectors concerned by SPS provisions (i.e. HS $\leq$ 24) and based on figure (3.4), larger ISO gaps are expected to occur in differentiated industries, such as prepared food (HS 16-24), which account for relative more certifications than homogeneous industries such as animal or vegetable products.

3.5.5 Interaction with quality ladder

Finally I look at the sectoral heterogeneity as described by equation 3.9, which interacts the TBT and SPS provisions with the quality ladder measure of the scope for quality improvement. The ladder measures the range between the smallest and the largest inferred quality for a given variety. As shown in figure (3.2), the ranking of average industry ladders remains more or less the same over time and is consistent with the degree of differentiability of goods. Therefore, I decide to use

the trade-weighted average over the sample period to end up with a measure at the country-pair-industry level. The variable $LadderFullRange$ is evaluated by taking into account the whole range of quality estimates and gives the difference between maximum and minimum qualities, whereas $LadderInterquartile$ computes the range between the 25^{th} and 75^{th} percentiles, allowing us to abstract from the potential effects of outliers. Both variables are continuous.

Results, reported in tables (3.12) and (3.13), show that industries with larger scope for quality improvement (i.e. longer ladders) are more impacted by both mutual recognition and harmonization of TBT and SPS provisions. The results are similar for the two measures of quality ladder used, full range and inter-quartile, showing that even after trimming outliers and hence reducing the ladder range, TBT and SPS provisions still have different sectoral effects. As competition increases following a bilateral or regional integration, firms will be pushed to improve quality of their goods in order to vertically differentiate themselves and appeal to consumers' taste for quality. The wider the potential quality range (maybe for technical reasons), the easier it is for firms to differentiate and compete.

The results reported in the third columns of both the TBT and SPS tables show that a proper theoretical framework is required to understand the effect of harmonization. When I account for the scope of quality improvement, which varies with country pair and industry, harmonization provisions appear to be negatively correlated with quality. The interpretation of this result tells us that the quality of fully homogenous goods is negatively impacted by harmonization provisions (whereas mutual recognition provisions do not have any effect on homogenous goods). This

is related to the impact on trade of harmonization on homogenous versus differentiated goods found in the empirical literature. [Portugal-Perez et al., 2010] find that international harmonization of EU standards has a positive and significant impact on imports of electronics. Meanwhile, [Czubala et al., 2009] find that the same type of harmonization has a negative effect on imports of textiles and apparel, which are more homogenous than electronics. Standards have a dual impact on trade costs, as they bring adaptation costs but also reduce information costs. The opposite effects of standards harmonization on trade of homogenous and differentiated goods might reside in the relative weights of these information versus adaptation costs; assuming that differentiated goods benefit more from the information conveyed by standards. Harmonization of standards might divert trade of homogenous goods because it entails relatively high adaptation costs. Since I estimate quality from the import demand residuals, if imports decrease because of standards harmonization and if prices are sluggish to adjust to the new standards, then estimated quality should decrease.

3.6 Conclusion

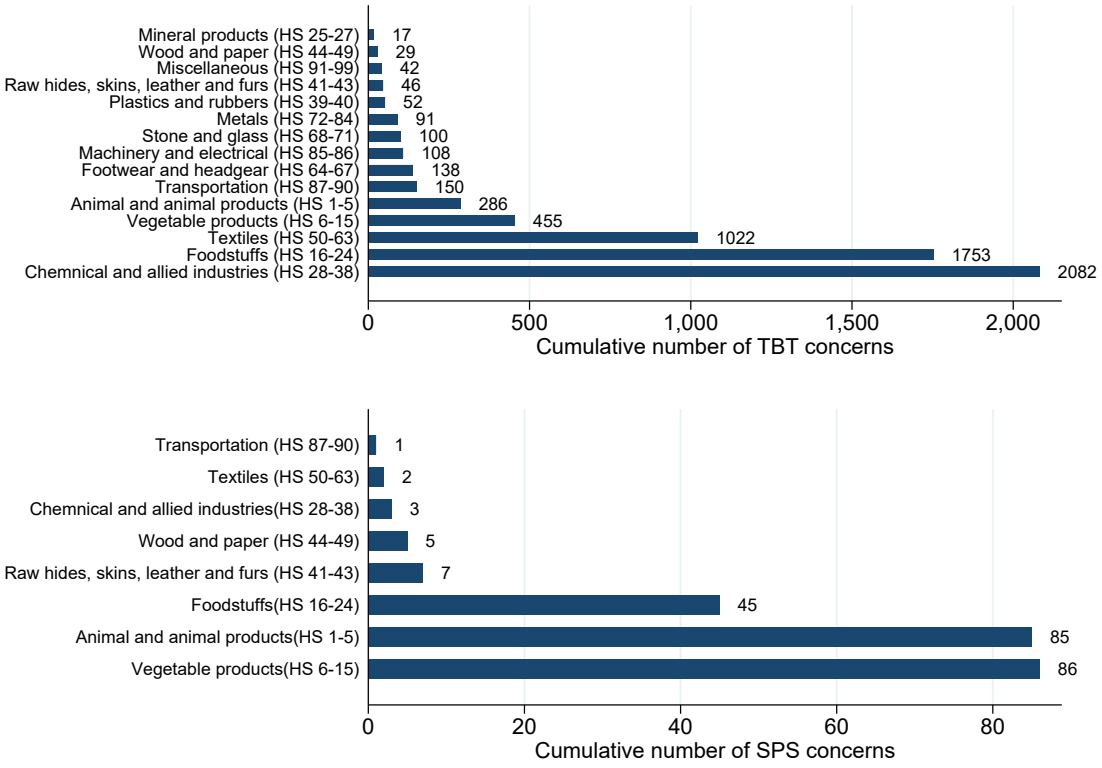
This empirical chapter contributes to the large literature that estimates the impact of PTAs. The novel dataset on the vertical Content of PTAs enables us to disentangle the various modes of integration. Results show that provisions matter differently for quality improvement.

I find that on average mutual recognition of TBT measures increases quality

by twice as much as harmonization, whereas quality benefits more from the harmonization of SPS measures than from mutual recognition. However, the baseline results hide a lot of heterogeneity across markets and sectors. Further exploration reveals that TBT and SPS provisions are more impactful whenever a developing country is involved in the PTA (this is in line with findings on the impact of deep PTAs on GVC trade [Laget et al., 2018] or FDI as shown in the next chapter). I also find big sectoral differences. Differentiated goods, which tend to display bigger scope for quality improvement, are positively impacted by TBT and SPS provisions whatever the mode of integration.

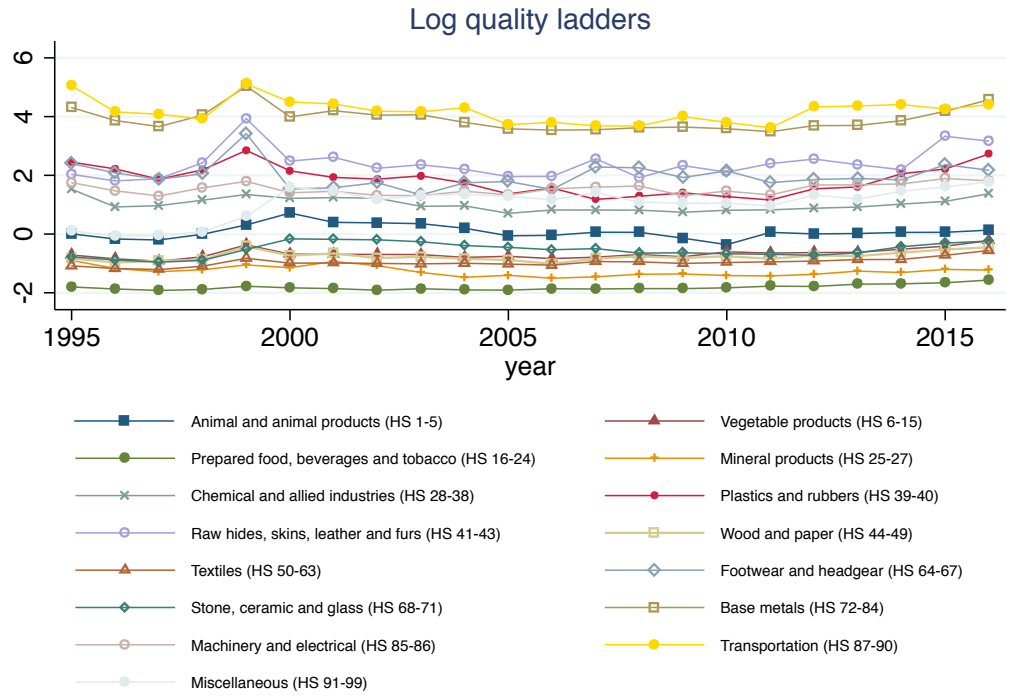
A large share of those effects is driven by country-pair effects revealing the presence of policy endogeneity. While the total depth of PTAs still has a positive and significant impact on quality after controlling for the pair fixed effects, the effects of the aggregate measures of mutual recognition or harmonization are either reduced or muted. This can be explained by the fact that, by nature, TBT/SPS provisions directly target issues on quality, whereas other provisions focus on different institutional challenges unrelated to health and safety issues.

3.7 Figures



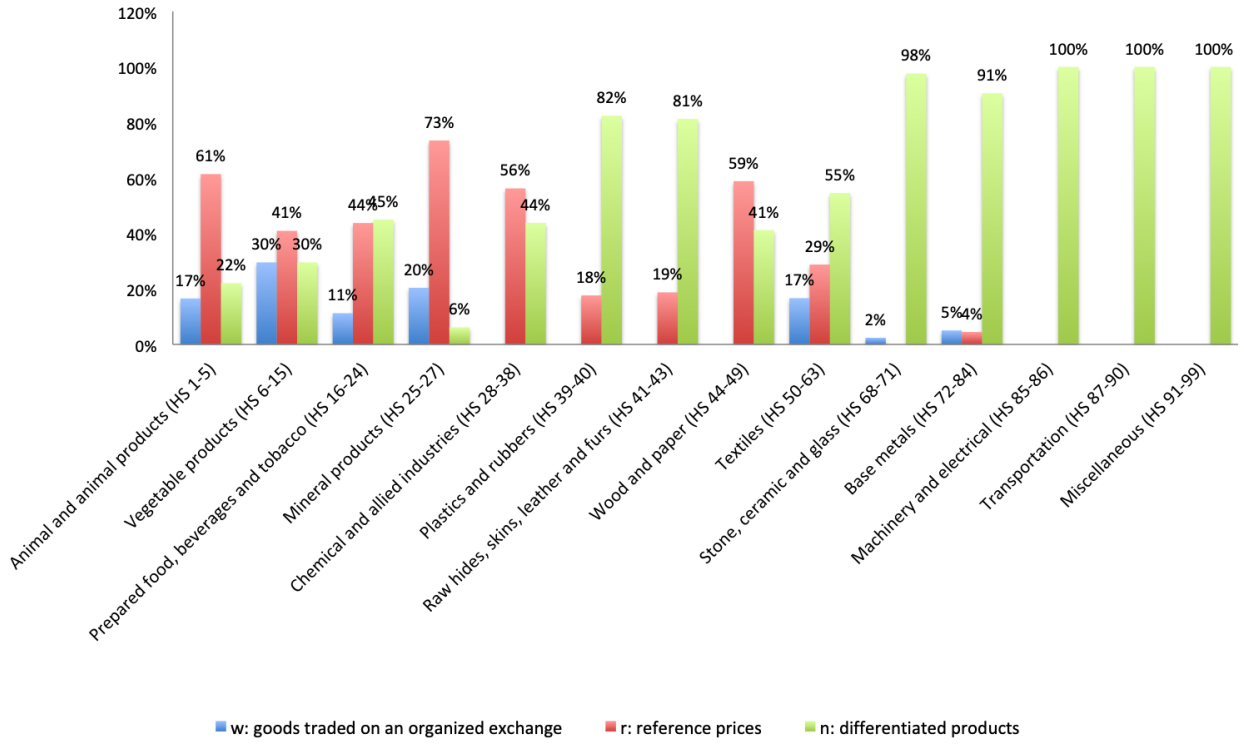
Source: WTO's TBT and SPS committee.

Figure 3.1: Number of concerns raised for SPS and TBT measures



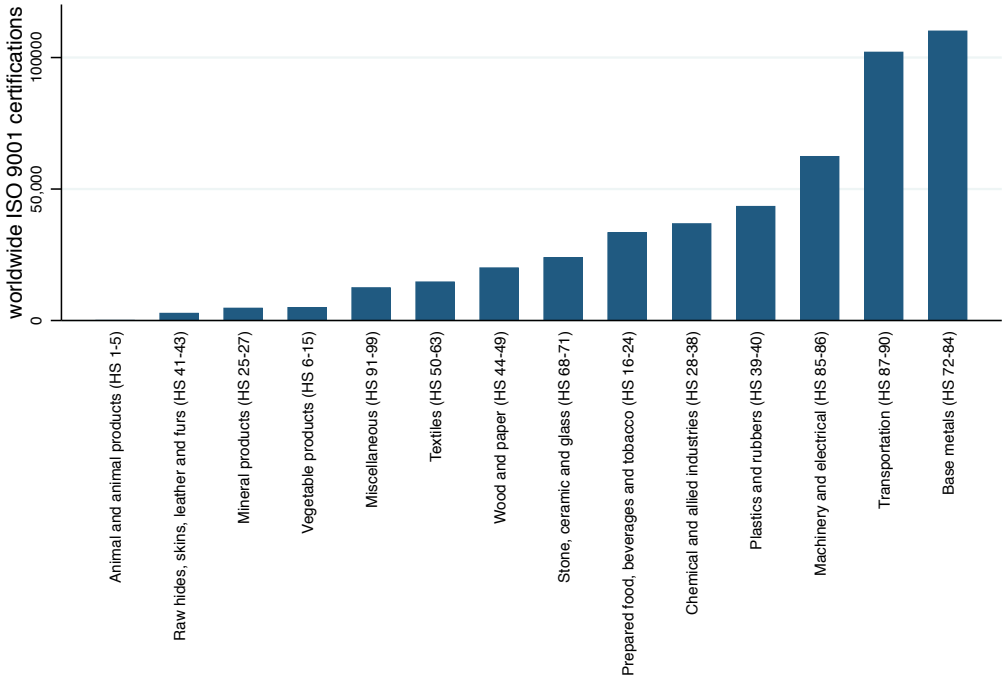
Source: Author's calculation based on estimated qualities.

Figure 3.2: Average quality ladders by broad industries



Source: Author's calculation based on STIC rev.2 and HS 1996 correspondence tables

Figure 3.3: Average correspondence between Rauch's and HS classificaiton



Source: ISO's annual survey on ISO 9001 standards certifications.
Note: Total number of ISO 9001 certifications granted between 2009 and 2014. Original SITC classification manually mapped to HS classification.

Figure 3.4: Total ISO 9001 certifications by broad HS industries

3.8 Tables

HS sections	BW median sigma
Animal and animal products (HS 1-5)	5.075
Prepared food, beverages and tobacco (HS 16-24)	4.25
Textiles (HS 50-63)	3.65
Vegetable products (HS 6-15)	3.35
Base metals (HS 72-84)	3.275
Wood and paper (HS 44-49)	3.2
Plastics and rubbers (HS 39-40)	3.125
Mineral products (HS 25-27)	3.05
Footwear and headgear (HS 64-67)	3
Chemical and allied industries (HS 28-38)	2.8
Transportation (HS 87-90)	2.55
Stone, ceramic and glass (HS 68-71)	2.4
Raw hides, skins, leather and furs (HS 41-43)	2.35
Machinery and electrical (HS 85-86)	2.2
Miscellaneous (HS 91-99)	2.2

Table 3.1: Elasticities of substitution from Broda and Weinstein (2006)

	Mean	Median	25th	75th
OLS price coefficient	0.009	0.011	-0.049	0.076
IV price coefficient	-0.969	-1.136	-2.815	0.353
F-stat of quality estimates	62	38	7	93
F-stat first stage	2925	2574	1605	3820
R-squared	0.700	0.701	0.682	0.730

Table 3.2: Summary statistics for the estimation of the import demand equation

VARIABLES	ln($quality$) population control (1)	ln($quality$) population control (2)	ln($quality$) population control (3)	ln($quality$) GDP control (4)	ln($quality$) GDP control (5)	ln($quality$) GDP control (6)
ln($PCGDP_{iht}$)	0.632***			0.572***		
	(0.0232)			(0.0230)		
ln(K_{iht}/L_{iht})		0.661***			0.596***	
		(0.0225)			(0.0223)	
ln($HighEduc_{iht}$)			1.584***			1.518***
			(0.292)			(0.302)
Observations	3,181,373	3,098,059	1,356,962	3,180,353	3,097,508	1,356,908
R-squared	0.417	0.422	0.518	0.341	0.345	0.421
Destination-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Product-time FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.3: Quality and factors of endowment

	log($UnitValue_{ijht}$)			
VARIABLES	(1)	(2)	(3)	(4)
log($quality_{ijht}^{popcontrol}$)	-0.0131***	-0.00947***		
	(0.000198)	(0.000164)		
log($quality_{ijht}^{popcontrol}$) × log($ladder_{ijht}$)	6.59e-05***			
	(0.00000281)			
log($quality_{ijht}^{popcontrol}$) × log($ladder_{ijht}^{interquartile}$)		1.30e-05***		
		(0.00000289)		
log($quality_{ijht}^{gdpcontrol}$)			-0.00330***	-0.00295***
			(0.000147)	(0.000128)
log($quality_{ijht}^{gdpcontrol}$) × log($ladder_{ijht}$)			6.92e-05***	
			(2.49e-06)	
log($quality_{ijht}^{gdpcontrol}$) × log($ladder_{ijht}^{interquartile}$)				1.65e-05***
				(1.73e-05)
Observations	3,096,827	3,096,827	3,084,433	3,084,433
R-squared	0.595	0.595	0.595	0.595
Product-year FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.4: Relationship between unit prices and quality

	p1	p5	p10	p25	p50	p75	p90	p95	p99
Animal and animal products (HS 1-5)	-7.52	-3.31	-1.85	-0.39	0.11	1.79	7.91	13.58	31.32
Vegetable products (HS 6-15)	-6.19	-2.13	-1.05	-0.19	0.18	0.89	2.81	5.70	19.28
Prepared food, beverages and tobacco (HS 16-24)	-2.14	-0.64	-0.33	-0.06	0.10	0.31	0.65	1.04	3.00
Mineral products (HS 25-27)	-5.14	-1.71	-0.80	-0.12	0.20	0.87	2.70	5.37	17.03
Chemical and allied industries (HS 28-38)	-3.83	-1.42	-0.70	-0.06	0.29	0.99	4.51	29.08	72.46
Plastics and rubbers (HS 39-40)	-6.74	-1.49	-0.55	0.11	0.82	4.65	14.91	23.67	47.53
Raw hides, skins, leather and furs (HS 41-43)	-7.47	-2.42	-1.16	-0.09	0.81	4.06	11.33	18.73	40.18
Wood and paper (HS 44-49)	-4.56	-1.40	-0.62	-0.03	0.34	0.95	2.88	6.30	18.34
Textiles (HS 50-63)	-3.10	-1.06	-0.48	0.02	0.42	1.17	3.03	5.62	17.22
Footwear and headgear (HS 64-67)	-9.12	-3.05	-1.46	-0.17	0.84	3.09	8.41	14.07	30.51
Stone, ceramic and glass (HS 68-71)	-6.08	-2.26	-1.15	-0.19	0.40	1.57	3.96	6.60	18.47
Base metals (HS 72-84)	-5.23	-1.09	-0.34	0.08	0.86	7.55	31.66	51.73	74.82
Machinery and electrical (HS 85-86)	-12.34	-2.39	-0.44	0.93	2.46	5.40	10.86	15.23	25.93
Transportation (HS 87-90)	-10.61	-2.31	-0.91	-0.04	0.41	9.27	31.95	46.37	69.78
Miscellaneous (HS 91-99)	-5.86	-2.41	-1.31	-0.22	0.65	2.50	6.86	12.00	29.25

Table 3.5: Distribution of quality estimates by broad sectors

	ln(*quality*)							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$TBT_{all}^{MutualReco}$	0.526***	0.0308						
	(0.103)	(0.0659)						
TBT_{all}^{Harmo}			1.100***	0.100				
			(0.0914)	(0.0638)				
$SPS_{all}^{MutualReco}$					0.593***	0.236**		
					(0.0800)	(0.117)		
SPS_{all}^{Harmo}							0.343***	-0.0331
							(0.0446)	(0.0407)
$TotalDepth$	0.0438***	0.00429***	0.0294***	0.00514***	0.0183***	0.00398***	0.0132***	0.00469***
	(0.00255)	(0.00136)	(0.00249)	(0.00145)	(0.00125)	(0.00123)	(0.00141)	(0.00136)
Observations	3,196,889	3,196,886	3,196,889	3,196,886	667,363	667,361	667,363	667,361
R-squared	0.435	0.465	0.436	0.465	0.231	0.253	0.231	0.253
Origin-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	No	Yes	No	Yes	No	Yes	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Baseline estimation of the impact of TBT and SPS provisions on average quality

	ln(*quality*)					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
$TBT^{MutualReco}_{Standard}$	0.224***					
	(0.0741)					
$TBT^{MutualReco}_{TechReg}$		0.224***				
		(0.0741)				
$TBT^{MutualReco}_{Conformity}$			0.232***			
			(0.0659)			
$TBT^{Harmo}_{Standard}$				0.111*		
				(0.0632)		
$TBT^{Harmo}_{TechReg}$					0.150**	
					(0.0621)	
$TBT^{Harmo}_{Conformity}$						0.137**
						(0.0622)
$TotalDepth$	0.0124***	0.0124***	0.0126***	0.0114***	0.0118***	0.0117***
	(0.00140)	(0.00140)	(0.00138)	(0.00136)	(0.00137)	(0.00136)
Observations	3,196,883	3,196,883	3,196,883	3,196,883	3,196,883	3,196,883
R-squared	0.456	0.456	0.456	0.456	0.456	0.456
Origin-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.7: Baseline estimation of the impact of TBT provisions on average quality

	ln(*quality*)			
VARIABLES	(1)	(2)	(3)	(4)
$SPS^{MutualReco}_{Standard}$	0.0258			
	(0.125)			
$SPS^{MutualReco}_{Inspection}$		0.194*		
		(0.115)		
$SPS^{Harmo}_{Standard}$			0.343*	
			(0.184)	
$SPS^{Harmo}_{Inspection}$				-0.0758
				(0.0488)
$TotalDepth$	0.00350***	0.00338***	0.00347***	0.00424***
	(0.00120)	(0.00120)	(0.00120)	(0.00127)
Observations	667,361	667,361	667,361	667,361
R-squared	0.216	0.216	0.216	0.216
Origin-time FE	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.8: Baseline estimation of the impact of SPS provisions on average quality

VARIABLES	$\ln(quality)$	
	(1)	(2)
$TBT_{all}^{MutualReco} \times NorthNorth$	-0.143**	
	(0.0717)	
$TBT_{all}^{MutualReco} \times NorthSouth$	0.324***	
	(0.110)	
$TBT_{all}^{MutualReco} \times SouthSouth$	0.923***	
	(0.226)	
$TBT_{all}^{Harmo} \times NorthNorth$		-0.0922
		(0.0795)
$TBT_{all}^{Harmo} \times NorthSouth$		0.226***
		(0.0734)
$TBT_{all}^{Harmo} \times SouthSouth$		0.272
		(0.216)
$TotalDepth$	0.00407***	0.00479***
	(0.00131)	(0.00140)
Observations	3,196,883	3,196,883
R-squared	0.456	0.456
Origin-time FE	Yes	Yes
Destination-time FE	Yes	Yes
HS2 FE	Yes	Yes
Pair FE	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.9: Impact of TBT measures on quality across development levels

VARIABLES	$\ln(quality)$	
	(1)	(2)
$SPS_{all}^{MutualReco} \times NorthNorth$	-0.242	
	(0.364)	
$SPS_{all}^{MutualReco} \times NorthSouth$	0.336*	
	(0.172)	
$SPS_{all}^{MutualReco} \times SouthSouth$	0.0969	
	(0.152)	
$SPS_{all}^{Harmo} \times NorthNorth$		0.0405
		(0.0588)
$SPS_{all}^{Harmo} \times NorthSouth$		-0.0772
		(0.0546)
$SPS_{all}^{Harmo} \times SouthSouth$		-0.0534
		(0.0774)
$TotalDepth$	0.00333***	0.00423***
	(0.00120)	(0.00134)
Observations	667,361	667,361
R-squared	0.216	0.216
Origin-time FE	Yes	Yes
Destination-time FE	Yes	Yes
HS2 FE	Yes	Yes
Pair FE	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.10: Impact of SPS measures on quality based on the level of development of partners

VARIABLES	ln(*quality*)			
	(1)	(2)	(3)	(4)
$TBT^{MutualReco_{all}}$	0.0730***			
	(0.0255)			
$TBT^{MutualReco_{all}} \times iso_{9001}^{gap}$	-355.3			
	(376.1)			
$TBT^{Harmo_{all}}$		0.0417*		
		(0.0226)		
$TBT^{Harmo_{all}} \times iso_{9001}^{gap}$		0.608		
		(8.142)		
$SPS^{MutualReco_{all}}$			0.183	
			(0.122)	
$SPS^{MutualReco_{all}} \times iso_{9001}^{gap}$			-13.62***	
			(2.996)	
$SPS^{Harmo_{all}}$				-0.00953
				(0.0274)
$SPS^{Harmo_{all}} \times iso_{9001}^{gap}$				-11.33**
				(5.057)
iso_{9001}^{gap}	-7.815	-7.735	-14.93	-14.94
	(36.80)	(36.77)	(17.79)	(17.78)
$TotalDepth$	0.0122***	0.0115***	0.00317**	0.00343**
	(0.00141)	(0.00138)	(0.00126)	(0.00134)
Observations	3,099,089	3,099,089	650,400	650,400
R-squared	0.458	0.458	0.215	0.215
Origin-time FE	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.11: TBT/SPS measures interaction with ISO 9001 certification gap

VARIABLES	ln(*quality*)			
	(1)	(2)	(3)	(4)
$TBT_{all}^{MutualReco}$	0.0560	0.0275		
	(0.0653)	(0.0523)		
$TBT_{all}^{MutualReco} \times LadderFullRange$	0.0103*			
	(0.00623)			
$TBT_{all}^{MutualReco} \times LadderInterquartile$		0.0325***		
		(0.0122)		
TBT_{all}^{Harmo}			-0.163***	0.109**
			(0.0629)	(0.0497)
$TBT_{all}^{Harmo} \times LadderFullRange$			0.0311***	
			(0.00568)	
$TBT_{all}^{Harmo} \times LadderInterquartile$				-0.0131
				(0.00993)
$LadderFullRange$	0.363***		0.361***	
	(0.00188)		(0.00190)	
$LadderInterquartile$		0.648***		0.670***
		(0.00298)		(0.00323)
$TotalDepth$	0.00132	0.00144	0.00139	0.00160
	(0.00108)	(0.00107)	(0.00115)	(0.00116)
Observations	3,096,694	3,096,694	3,096,694	3,096,696
R-squared	0.599	0.611	0.599	0.620
Origin-time FE	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.12: Interaction between TBT measures and ladder length

VARIABLES	ln(*quality*)			
	(1)	(2)	(3)	(4)
$SPS_{all}^{MutualReco}$	-0.173	0.145		
	(0.124)	(0.106)		
$SPS_{all}^{MutualReco} \times LadderFullRange$	0.157***			
	(0.0335)			
$SPS_{all}^{MutualReco} \times LadderInterquartile$		0.0832**		
		(0.0390)		
SPS_{all}^{Harmo}			-0.148***	-0.00345
			(0.0323)	(0.0270)
$SPS_{all}^{Harmo} \times LadderFullRange$			0.0483***	
			(0.00772)	
$SPS_{all}^{Harmo} \times LadderInterquartile$				0.0403***
				(0.0109)
$LadderFullRange$	0.279***		0.269***	
	(0.00480)		(0.00489)	
$LadderInterquartile$		0.461***		0.471***
		(0.00798)		(0.00871)
$TotalDepth$	0.00333***	0.00204*	0.00409***	0.00251**
	(0.00111)	(0.00108)	(0.00111)	(0.00125)
Observations	645,996	645,996	645,996	645,996
R-squared	0.388	0.359	0.390	0.394
Origin-time FE	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes
Pair FE Yes Yes Yes Yes				

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.13: Interaction between SPS measures and ladder length

Chapter 4: Deep PTAs and FDI

4.1 Disclaimer

This chapter is adapted from joint work with Nadia Rocha and Gonzalo Varela. It has not undergone the review accorded to official World Bank publications. The findings, interpretations, and conclusions expressed herein are those of the authors and do not necessarily reflect the views of the World Bank Group and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent

4.2 Introduction

Because investment is complementary to trade, PTAs provide relevant institutional frameworks to partner countries that wish to regulate their mutual foreign investments. In this chapter, we study the impact of deep trade agreements on foreign direct investment (FDI) decisions, and examine three sub-questions. First, is the impact of trade agreements on FDI heterogeneous across types of business activities? Second, is this impact heterogeneous across disciplines covered in the agreements? Third, does the level of development of home and host countries mat-

ter for this impact? We exploit the World Bank's dataset on the content of PTAs and data on bilateral greenfield investment decisions at the activity level. We find that deep trade agreements matter for investment decisions: every additional discipline into a PTA increases FDI by 1.4 percent, on average. Deep agreements do not impact FDI in natural resources and extractive activities, and have heterogeneous effects across production and services related activities. Results also reveal that disciplines that go beyond the mandate of the WTO matter more for FDI. Disciplines related to investment liberalization and protection, IPR or migration stand out to increase FDI, whereas disciplines on labor market regulations reduce investment. Finally, we find that our results are mostly driven by investment between developed and developing countries.

As PTAs are growing in number and deepening in content, the growing fragmentation of production has shifted the composition of trade towards more flows of differentiated intermediate products and less of homogenous goods. This has resulted into a rise in global value chains (GVC), reinforcing the need to concurrently regulate the exchange of goods and services with FDI under a common framework [Antràs and Staiger, 2012]. Moreover, Bilateral Investment Treaties (BITs) that have traditionally regulated foreign investments are losing ground as more investment related disciplines are incorporated in PTAs (see Figure 4.8). By removing economic uncertainty regarding market access rules and beyond the border business conditions, PTAs are increasingly relevant in the context of cross-border trade and investment. Their prevalence has revived interest in the literature on regionalism, as researchers examine the role of this new generation of deep trade agreements in

shaping the exchange of goods and services as well as investments. Understanding the economic effects of PTAs is essential to design and implement them efficiently.

This chapter contributes to the large debate on the economic impact of deep trade agreements by empirically investigating the key disciplines that promote FDI. We use a new dataset on the content of PTAs developed by the World Bank and bilateral cross-border data on greenfield investments run by the Financial Times. The latter provides information on the sector and business activity associated with an FDI operation. An activity defines the actual function of a project and can be described as a task along the supply process to end-users: from upstream research and development, passing by manufacturing (i.e. production), to downstream sale and retail. We argue that these activities provide a better understanding of which parts of the supply chain are most impacted by PTAs than sectors defined by standard industrial classification.[1]

After quantifying the average relationship of deep trade agreements on FDI, we explore three sources of heterogeneity in this effect, to reveal which factors drive our results: i) by sector - we first distinguish FDI by the type of business activity that is financed (differentiating between extractives, production and services related activities); ii) by type of discipline - we isolate the effect of specific disciplines included in PTAs; and iii) by level of development of the signatory countries. The first exercise relates to the impact of PTAs on resource seeking FDI, the possibility to isolate investment in extractive activities inform us on resource driven FDI. Studying

[1]Indeed, because a sector characterizes the end-use of goods or services provided by an FDI recipient, it generally entails a succession of activities and does not allow to accurately locate which part of the supply chain is involved on the FDI operation.

the impact of individual disciplines give us some hint on the efficiency seeking motive of FDI. By lowering the cost and uncertainty to do business across borders, deep PTAs facilitate operations along the value chains. Finally the third exercise which focuses on income differences between partners inform us on market seeking FDI. The literature has shown that this category of horizontal FDI tends to occur more between developed and developing countries.

Our key finding is that deep PTAs matter for FDI between member countries. Their positive impact persists even after accounting for the presence of BITs or shallow PTAs, which confirms that the disciplines covered in deep PTAs go beyond the commitments of traditional agreements. Adding a discipline to a PTA increases FDI by 1.4 percent. This result is driven by production and services related activities, and we also find that deep PTAs do not affect investments in resource extraction activities. We then estimate separately the impact of individual disciplines[2] related to investments. Among the core disciplines of PTAs - i.e. those disciplines that have a clear economic content, as opposed to other disciplines that do not (e.g. cultural cooperation, anti-terrorism), those that matter for FDI are: investment, intellectual property rights (IPR), visa and asylum, environmental laws, labor market regulations, movement of capital and competition policy. We find that all have a large and positive impact and increases FDI in service-related activities between 32 and 50 percent. However, labor and environmental disciplines decrease FDI in

[2]There are 18 core disciplines, which include tariff liberalization for industrial and agriculture goods, technical barriers to trade (TBT) and sanitary and phythosanitary (SPS) measures, export taxes and anti-dumping and countervailing measures, trade related intellectual property (TRIPs) and trade related investment measures (TRIMs), movement of capital, state owned enterprises, state aid, competition policies, intellectual property rights (IPR), investment, public procurement and services.

production-related activities by 48 and 110 percent respectively, while the remaining disciplines have no significant impact. Production activities tend to employ relatively more low-skill workers and are more polluting than services activities, two characteristics that make stringent labor market regulations and environmental laws more binding.[3] Finally, we find that our discipline level results are driven by businesses between developing and developed economies for which the prior regulatory gap is the widest.

The results on services and development level are consistent with what the GVC literature has found.[4] One of the reasons for these mirroring responses to deep PTAs is the catalyst role that FDI plays on GVC integration by providing foreign capital and technical know-how. Research has demonstrated that this high degree of complementarity between GVCs and FDI is enhanced by policies, such as those included in deep PTAs, providing support to the entry and upgrading in GVCs.[5]

4.3 Related literature

The economic effects of PTAs have been thoroughly studied in the literature. Researchers have looked at their impact on trade flows, investment, growth and welfare. Our paper relates to the strand that studies the role of trade agreements in

[3] On the contrary, service activities tend not to be adversely affected by labor and environmental disciplines because of the high-skill intensity and intangibility of such activities.

[4] Using sectoral data on value added trade, [Laget et al., 2018] find that deep PTAs matter more for GVC trade in services and have a larger impact for trade in intermediates between developed and developing countries.

[5] See the studies on FDI spillovers in the context of GVCs [Amendolagine et al., 2017] and [Farole and Winkler, 2014].

increasing cross-border investments through different channels. One potential channel is driven by the complementarity between trade and investment that is based on the production structure of multinational enterprises.[6] [Markusen and Maskus, 2002] provides a comprehensive framework to analyze and understand these mechanisms. A core argument is that, by reducing trade barriers, PTAs facilitate the exchange of inputs (tangible or not) and therefore stimulate investments along the value chain. An important implication is that the trade creation and trade diversion effects of PTAs may translate into FDI relocation, [Baltagi et al., 2008] and [Tintelnot, 2017] provide empirical and counterfactual evidencefor this mechanism.

Another channel linking PTAs with FDI comes from the liberalization of service, investment and other behind-the-border disciplines. [Dee and Gali, 2005] show that PTAs in general have a significant impact on investment flows through their non-trade disciplines. [Büthe and Milner, 2008] offer a political economy perspective and argue that PTAs serve as commitment mechanisms to foreign investors regarding the treatment of their assets that is more credible than domestic regulations. [Osnago et al., 2015] find that deep trade agreements facilitate vertical FDI because they reduce the contractual uncertainty associated with the difference between PTA members' institutions.

In terms of methodology, recent works have grasped the importance of accounting for the variation in content to distinguish the effects of deep versus shallow PTAs. Advances in data availability regarding the content of PTAs have enabled re-

[6]The relationship between trade and FDI is complex and both "tariff jumping" substitutability and "value chain" complementarity motives are supported by the theoretical analysis. [Fontagné, 1999] bring empirical evidences for the dominance of the complementarity relationship.

searchers to depart from the use of restrictive dummy variables and incorporate more sophisticated measures of PTA depth. Equipped with these new empirical tools, some papers have focused on the impact of PTA depth on trade flows, while others have addressed the same question for FDI. [Mattoo et al., 2017] find that deep trade agreements increase gross trade and can have a positive spillover effect on trade with third countries if their design and implementation are non-discriminatory. [Orefice and Rocha, 2014] study trade in parts and components, and [Laget et al., 2018] study trade in value added, both finding that deep PTAs increase countries' participation in GVCs by enhancing regulatory frameworks and easing cross-border operations. On the FDI side, [Lesher and Miroudot, 2006] construct an index of investment disciplines in PTAs but limit their coverage to 24 North-South agreements. Several papers have attempted to build similar type of indices based on careful analysis of the information contained in agreements' treaties. However, conducted this exercise on the universe of PTAs as well as their overall content, until the World Bank's Content of PTA database became available. [Osnago et al., 2015] are the first to use this dataset to construct a comprehensive measure of PTA depth and use it to explore the impact of deep integration on vertical investments.

Several papers analyze the impact of specific policy areas on foreign investments (whether applied domestically or multilaterally). Examples are: [Helpman, 1992], [Ferrantino, 1993], and [Mansfield and Lee, 1996] for the impact of Intellectual Property Rights; [Javorcik and Spatareanu, 2005] for labor market regulations; and [Hanna, 2010] for environmental laws. However, by approaching each of these disciplines separately, this body of research omits the important role provided by a

broad PTA framework in shaping the exchange of goods, services, and investments. We fill this gap by exploring the role of relevant disciplines for FDI within the framework of deep PTAs. Finally, our paper also relates to the strand of literature that studies the determinants of FDI involving developing countries. [Gómez-Mera et al., 2014] show how PTAs channel market seeking FDI from developing countries. Similarly to our results, [Medvedev, 2012] finds that the positive relationship between FDI and PTA is driven by North-South investment.

Our quantitative analysis is performed using a gravity model of investment to test first the impact of overall integration, and then the role of specific disciplines, in promoting cross-border investment flows. Following cutting-edge research on gravity models of trade, we use a Pseudo Poisson Maximum Likelihood (PPML) strategy to address the methodological challenge of the large number of zeros in bilateral investment data. To the best of our knowledge, this paper is the first to analyze the role of specific disciplines on foreign investment within the context of a PTA. Our large time and country coverage, as well as activity-level information, enable us to shed light on important heterogeneity in our results.

The rest of the paper is organized as follows; Section 2 introduces the data used to identify the content of PTAs and the data used to measure bilateral investment; Section 3 describes the methodology used for our empirical analysis; Section 4 discusses our findings, Section 5 presents robustness checks and addresses endogeneity concerns; and Section 6 concludes.

4.4 Data

In this section, we discuss the data used to measure the depth of a trade agreement and describe in detail our source for data on bilateral investments at the sector and activity level.

4.4.1 Preferential trade agreements

We first estimate the overall effects of deep trade agreements by using a new measure of depth. We then estimate the effects of specific disciplines included in PTAs. Our variables of depth and disciplines come from the first version of the World Bank database on the Content of PTAs.

For our baseline measure of depth, we simply follow previous works that use this content dataset or other similar sources, by counting the number of disciplines included in a PTA. We focus on the number of legally enforceable disciplines as they are expected to be more impactful than disciplines that are mentioned in treaties without any sign of substantial commitment from the parties. Specifically, we define the variable $TotalDepth_{ijt} = \sum_{k=1}^{52} Disc_{ijt}^{k}$ - i.e. the simple count of dummy variables for legally enforceable disciplines $Disc_{ijt}^{k}$ included in the agreement between country i and j at time t. Once an agreement is ratified, its content is not expected to change unless there is an enlargement in the future. The variable takes a value of zero before an agreement is signed and then turns on to the above sum after the signature, and remains the same until the end of the sample period. Therefore, the identification of the impact of depth variable comes from time variation within

each pair of countries

Another way to measure depth is to separate the disciplines between those that fall under the current mandate of the WTO (such as tariffs, customs and anti-dumping) and those that go beyond this mandate and are not subject to any kind of WTO agreements (examples are agreements on investment, competition policy, labour market laws, or environmental regulations). Following [Horn et al., 2010] we call the former measure of depth WTO-plus and the latter WTO-X and define them as: $WTOplus_{ijt} = \sum_{p=1}^{14} Disc_{ijt}^{p}$ and $WTOextra_{ijt} = \sum_{x=1}^{38} Disc_{ijt}^{x}$, where $disc_{ijt}^{p}$ are 14 WTO+ disciplines and $Disc_{ijt}^{x}$ are 38 WTO-X disciplines included in an agreement between countries i and j in year t (see tables (A.1) and (A.2) for the list of disciplines).

In the second stage of our analysis, we use dummy variables to identify the commitment towards individual disciplines in PTAs. While including these dummies sequentially, we also make sure that we control for the rest of the PTA content by including a measure of the "remaining" depth as the sum of disciplines except the one singled out in the specification. We sequentially test all the disciplines mapped in the database, eventually restricting ourselves only to those having a significant impact on FDI. As shown in figure (4.8), the selected disciplines are also the most frequent WTO-X areas included in PTAs.

4.4.2 Investments

In this section we describe the data source for our dependent variable measuring cross-border investments. Reliable investment data is not as readily available as trade data. When available, the data usually come from surveys conducted by central banks or statistical offices and are used to comply with reporting obligations, such as balance of payments or international investment position statistics. Such data reporting often lacks uniformity across countries, which undermines its quality.[7] Also, investment data are rarely available at the bilateral sectoral level. To circumvent these limitations, we use investments from the fDi Markets database collected by fDi Intelligence, a division of Financial Times. The data is available at the firm-project level and corresponds to announcements of "Greenfield FDI in a new physical project or expansion of an existing investment, which creates new jobs, and capital investment". The announcements are collected from publicly available sources, such as media sources, industry and investment promotion agencies, or market search and publication companies. Each project identified is cross-referenced against multiple sources.

One concern is that recorded announcements differ in their advancement. The dataset includes (but does not clearly distinguish) FDI projects that have been announced or opened by a company, which either means that firms have made their final decision and projects are moving towards implementation in the former case, or

[7] Despites the international reporting practices set by the IMF, countries tend to i) deviate from the 10 percent ownership threshold used to define FDI, ii) not use uniform industry classification, or iii) not report all types of investment properly (short-term intra-company loans, re-invested earnings are often missing).

are already fully operational in the latter.[8] Yet, to the extent possible, project status is updated if a company makes further announcements. Large announced projects above $1bn are researched on a quarterly basis to verify their progress. If the project is cancelled, it is removed from the database. Working with announcements represents an important advantage for our identification strategy in that it reduces the scope for endogeneity caused by simultaneity.[9] fDi Intelligence mentions that it takes on average two years for a project to materialize after an announcement is made in the media. Hence, regressing announcements on PTA variables at time t is equivalent to regressing investment disbursement on lagged PTA variables, which is one of the common techniques used when there is concern about endogeneity. Another advantage of using the fDi Markets database is the availability of company-level investment data. This allows us to address endogeneity concerns related to the fact that large investment decisions may determine the adherence to certain disciplines in PTAs by host countries, which would imply that it is large investments that determine PTAs rather than the opposite. This is why, in the final part of our analysis, we remove the largest investments from the sample, as well as the sectors that spend the most resources in lobbying for specific content in PTAs, to check robustness of results to that potential source of endogeneity.

Overall, the data covers more than 60,000 companies from 177 source countries investing in 162 destination countries from 2003 to 2015. Each company's project is

[8]The data does not cover merger and acquisition or other equity and non-equity investments. Typically, projects are captured at the announcement stage for capital-intensive projects and at the opening stage of services operations with limited capital investment required. Capital-intensive projects take on average 2 years to become operational.

[9]Recent academic research using fDi Markets data includes: [Crescenzi et al., 2013]; [Paniagua and Sapena, 2014]; [Castellani and Pieri, 2016]; [Amoroso et al., 2015]; [Antonietti et al., 2015]

classified according to 39 industries and 18 business activities based on end-users. Table (4.9) shows how the different sectors and activities overlap in the data. Business activities are defined as the actual function of a project, whereas sectors are based on the receiving company's core business area. Examples of project's announcements are: Wiseway Group (Australia — a transportation services provider) is investing in China in the Transportation industry in a project related to Sales, Marketing and Support activity; ProLogis (United States — a leasing and property management company) is investing in Sweden in the Real Estate industry in a construction project. This means that an industry traditionally classified as manufacturing may receive investments to develop a service-related activity and vice versa. In the data for example, 65 percent of the investment received by the "consumer electronics" sector is dedicated to production activities but 16 percent falls in retail, 5 percent in research and development, 4 percent in marketing, 2 percent in logistics, distribution and transportation, and so on (all service-like activities). We think that these activities best describe operations along the supply chain.

In figure (4.3), we compare our source for bilateral FDI announcements data with bilateral FDI data from UNCTAD. Even though the correlation fluctuates over time, on average our chosen measure of FDI tracks official data on cross-border investments relatively well. We explain the discrepancy by the fact that our data is not based on declarations of firms' balance sheets and therefore does not record the full set of balance of payment flows, which implies that our constructed measure of inward (or outward) FDI cannot perfectly match official measures. First, inward and outward notions require a reporting country, which is not the case for the fDi

markets data as its compilation is performed by experts from the Financial Times. Second, outward (inward) flows are computed by netting out any transactions that decrease the stake of resident (foreign) investors in foreign (resident) enterprises from transactions that increase it.

A crucial stage of the empirical work resides in dealing with the absences of announcements. As acknowledged in the trade literature, zero trade (or investment) flows do not occur randomly, which means that samples restricted on positive values may yield biased estimates. It is particularly important to account for zero flows when studying the effects of deep integration. The nature of our investment data necessitates assumptions concerning the presence of zero investment flows. Contrary to officially reported trade or investment data, we cannot apply the mirror method to complete missing observations, and lack of announcements in the news can be left to interpretation. Nevertheless, we assume that if a significant investment ever materializes, it will be covered in the news or announced in some other ways that fDi markets will be able to identify. We generate zero investment flows by doing the following: starting from the sample of countries included in the fDi markets database, we generate all possible source/destination pairs across the sample period and replace missing observations by zeros. We then keep only the pairs (for the whole period) that ever invested at some point during the period.[10]

Finally, we do not make assumption regarding the motives of investments. The data and its coarse industry/activity classification do not allow us to distin-

[10]This way, at the aggregate activity level our estimation sample is composed of 35 percent (38,300) non-zero against 65 percent (71,033) zero observations for FDI announcements.

guish between vertical and horizontal FDI. Even though the theoretical literature has long distinguished market seeking (i.e. horizontal) FDI and efficiency seeking (i.e.vertical) FDI ([Markusen, 1984], [Helpman, 1984], recent works have shed light on the complex strategies of multinationals. In this paper we study the impact of deep integration on the intention to invest in Greenfield projects in general.

4.4.3 Control variables

We control for existence of expired trade agreements by including a corresponding dummy variable. Past agreements are taken from Mario Larch's Regional Trade Agreements Database. We also control for bilateral investment treaties to isolate the effect of investment disciplines included in PTAs only. Finally, we use fixed effects to minimize the scope for endogeneity. We initially include country-pair, source-time and destination-time fixed effects. When we move to the business activity level, we control additionally for pair-industry, source-industry-time and destination-industry-time fixed effects.

4.5 Effect of PTAs on FDI

In this section we introduce the gravity model used to estimate the effect of the depth of a PTA on FDIs.

4.5.1 Empirical strategy

The gravity model is the workhorse estimation technique for applied international trade analysis. This model has both empirical and theoretical advantages; it predicts trade flows well and can be derived from a large class of structural general equilibrium trade models. Theoretical studies of multinationals and trade ([Markusen and Venables, 1998, Markusen and Venables, 2000], [Egger and Pfaffermayr, 2000]) have found that both types of activity are determined by the same exogenous factors (distance, market size, trade/investment barriers). Despite the lack of micro-founded theory to fit FDI patterns from gravity determinants (as [Anderson and van Wincoop, 2003] does for trade flows), the gravity model is a successful tool for predicting FDI flows and has frequently been used in the literature.

In our estimation strategy, we follow the best practices for estimating a structural gravity model. We use directional country-time fixed effects to account for the multilateral resistance terms. These fixed effects absorb any country-specific characteristics that may vary with time, such as national policies, institutions and exchange rates. Because we use panel data, we can incorporate country-pair fixed effects to account for time invariant differences between origin and destination countries, such as factor endowments, that can predict FDI flows. By including this extensive set of fixed effects, we alleviate the risk of endogeneity caused by omitted variables. Finally, we rely on the Pseudo Poisson Maximum Likelihood (PPML) estimator, which has been commonly adopted to estimate gravity equations. [Santos Silva and Tenreyro, 2006] shows that this non-linear estimator produces consistent estimates

in the presence of heteroskedasticity while accounting for the large number of zero flows.

Initially, we estimate our baseline specification using both OLS and PPML methods to show that both estimators lead to similar results.

$$OLS: \log(FDI_{ijt}) = \beta_1 Depth_{ijt} + Bcontrols_{ijt} + \delta_{ij} + \delta_{it} + \delta_{jt} + \epsilon_{ijt} \quad (4.1)$$

$$PPML: FDI_{ijt} = \exp\left(\beta_1 Depth_{ijt} + Bcontrols_{ijt} + \delta_{ij} + \delta_{it} + \delta_{jt}\right) + \epsilon_{ijt} \quad (4.2)$$

where FDI_{ijt} measures greenfield investments between country i and j at time t, $Depth_{ijt}$ is a measure of PTA depth, $controls_{ijt}$ are dummy variables accounting for present and past PTA agreements (PTA_{ijt} and $pastPTA_{ijt}$ respectively), and bilateral investment treaties (BIT_{ijt}); and δ_{ij}, δ_{it}, and δ_{jt} represent respectively country-pair industry, reporter-industry-time and partner industry time fixed effects.

4.5.2 Baseline results

Table (4.2) reports the coefficients of total depth, WTO-plus and WTO-extra variables for both OLS and PPML estimators. The first three columns columns are estimated with OLS and show that the total depth of PTAs matters for investment, whereas a shallow measure of PTAs using only a dummy variable does not have a significant effect. The bilateral investment treaty dummy is not significant, which is also the case in the literature when the effects of BITs and PTAs are estimated concurrently. Moving to the best practices for the gravity estimation, which rec-

ommend using PPML, we find that the total depth variable is also significant and positive when using the PPML estimator. One additional discipline increases FDI announcements by 1.4 percent. Splitting the depth of the PTAs between WTO-plus and WTO-extra disciplines as done in columns (4) and (6) of table (4.2), we find that the disciplines that go beyond the WTO's mandate drive the positive effects. In table (4.3), we test whether deep PTAs matter for FDI in extractive activities. The interaction with a dummy for extraction shows that deeper agreements do not promote FDI in extraction as opposed to services and production activities. This confirms that deep PTAs really apply to more complex activities that are more rules-intensive. Consequently, for the rest of our analysis we focus on production and service activities only. These baseline results are in line with results from similar specifications regressing GVC trade on the total depth of PTAs (see [Laget et al., 2018]). They illustrate the fact that investment and value-added trade are two manifestations of the same GVC activities. In the next section we further investigate the effects of specific disciplines.

4.5.3 The impact of single disciplines

The data on the content of PTAs allows us to isolate the effect of single disciplines on investment while controlling for the overall depth. The following specification estimates the effect of investment related disciplines while accounting for the rest of a PTA depth:

$$FDI_{ijt} = \exp\left(\beta_1 Depth_{ijt}^{\notin d} + \beta_d Disc_{ijt}^{d} + Bcontrols_{ijt} + \delta_{ij} + \delta_{it} + \delta_{jt}\right) + \epsilon_{ijt} \quad (4.3)$$

where $Disc_{ijt}^{d}$ is a dummy variable that indicates whether the discipline d is included in an agreement. The variable $Depth_{ijt}^{\notin d}$ controls for the rest of the agreement content summing across all other disciplines except d. Table (4.4) reports the results of the PPML estimation at the discipline level. Commitments relative to intellectual property rights (IPR) increase FDI announcements by 36 percent. When included in PTAs, IPR protect investors' main assets (brand or innovation efforts) and guarantee secured returns on those assets. Visa and asylum increases FDI announcements by 43 percent shedding light on the importance of facilitating the movement of persons to promote business activities. On the other hand, labor market regulations are negatively correlated with FDI and decreased announcements by 80 percent. The main objective of labor disciplines is not to increase market access but rather to improve social welfare by fostering workers' bargaining power, which does not liberalize the business environment.

At this point, it is worth commenting on the magnitude of the coefficients of the disciplines in table (4.4) relative to the coefficient of the total depth variable, which is computed as the sum of discipline dummies. Some of these disciplines have a significant and positive impact, while others have a negative impact or no impact at all on FDI. For this reason, summing all the individual effects is netting out positive and negative impacts and results in a much smaller absolute coefficient for total depth. Moreover, accounting for the difference in range and variance of the aggregate depth vs. disciplines, we find that a one standard deviation increase in total depth is associated with a 0.04 standard deviation increase in FDI and a one standard deviation increase in IPR is associated with a 0.03 standard deviation

increase in FDI.

The next estimation studies the potential heterogeneity in the effect of disciplines across business activities. We create a dummy variable that identifies services activities. *Services* refers to any activity that is neither production nor extractive that we interact with the discipline dummy. Since we have excluded extractive activities from the rest of the analysis, the control group represents the production activities. Table (4.9) summarizes the distribution of the FDI announcements across business activities and shows that our sample is biased towards services (with 53 percent of the outstanding amount of announcements for services projects, 37 percent for manufacturing, and 9 percent for extractive). The new specification is written:

$$\begin{aligned} FDI_{ijt} = \exp(&\beta_1 Depth_{ijt}^{\notin d} + \beta_d Disc_{ijt}^{d} + \beta_d^{'} Disc_{ijt}^{d} \times Services \\ &+ Bcontrols_{ijt} + \delta_{ij} + \delta_{it} + \delta_{jt}) + \epsilon_{ijt} \end{aligned} \tag{4.4}$$

Table (4.5) reports the results of the interactions with service-related activities. Our eight disciplines of interest turn out to be positively correlated with announcements of projects related to service activities. Service activities, that are skill- and knowledge-intensive, benefit the most from the reduction of uncertainty conferred by PTAs. As for environmental laws, when production and service activities are combined, this discipline is not significant, but separating the effects on each activity reveals that such discipline is negatively correlated with the intention to invest in production activities. This might be because environment policy areas cover commitments on Good Manufacturing Practices that "constraint" mostly production

processes. We would need measurement on the vertical depth to test this hypothesis. The opposite effects of labor market regulations found for services and production can be explained by the difference in workers' skill employed in those two types of activities. On top of ILO labor standards (prohibition of child labor, respect of human right, and so on.), labor disciplines in PTAs cover (and are not limited to) right to collective bargaining, freedom of association, minimum wages, unemployment benefit, cost of firing. Such regulations tend to bind for low-skilled workers and hence refrain investors from investing in production-like activities, which tend use more unskilled workers than services.

As mentioned in the introduction, business activities can be viewed as "tasks" performed along the supply chain, and are different from standards industrial classifications. Therefore, significant effects on services activities but none on manufacturing activities should not be interpreted as an absence of impact on goods. Indeed, products from the textile sector have attracted 18 percent of investment on manufacturing activities, but also 77 percent on retail services activities.

4.5.4 Level of development

The content of trade agreements varies greatly with the level of development of signatories and disciplines may matter differently for developed or developing countries. We first investigate the interaction between the overall PTA depth and the level of development of partner countries. We then use the same type of interaction to understand how the effects of disciplines varies with the development level. The

regression specification is as follows:

$$FDI_{ijt} = \exp(\beta_1 Depth_{ijt}^{\notin d} + Depth_{ijt}^{\notin d} \times Dev_{ij} + \beta_d Disc_{ijt}^{d} + \beta_d^{'} Disc_{ijt}^{d} \times Dev_{ij} + Bcontrols_{ijt} + \delta_{ij} + \delta_{it} + \delta_{jt}) + \epsilon_{ijt} \tag{4.5}$$

Where Dev_{ij} is a vector of three dummies of the possible North-North, North-South and South-South country pairs. North is defined as the group of high-income countries while South comprises low- and middle-income and LDC countries.

Results reported in table (4.6)show that North-South agreements are driving our results on overall depth. Without interaction we found in the baseline specification that an additional discipline increase FDI by 0.14 percent regardless of the development level of the member countries. This effect rises to 0.24 percent for FDI between developed and developing countries. Moreover, investment, IPR, labor market regulations and movement of capital have a bigger positive and significant impact on FDI between North-South than pairs of similar income. This sheds light on the role that such disciplines can play to enhance the investment climate and provide stability, two factors that are critical when prior institutional gap is the widest as in between developed and developing countries.

The absence of significant effect of South-South agreements (at both overall and discipline levels) is due to the fact that such PTAs rarely included $WTO-X$ disciplines and hence do not significantly commit on investment related issues. On the contrary, North-North agreements often include investment-related disciplines, but

institution levels being already similar across high-income countries, commitment established in PTAs do not influence the pattern of FDI between these countries.

4.6 Robustness checks

4.6.1 Composition concerns

There is evidence supporting the existence of templates for the content of trade agreements, which are championed by the US and the EU, the two major economies leading active regional integration agendas (see [Horn et al., 2010]). This raises concerns about the validity of our results and questions the existence of a composition effect.

To test whether our findings are driven by the presence of such templates, we run our specifications by sequentially removing countries from the estimation samples. We find that both baseline and discipline level estimations remain the same, ruling out any role played by a particular economy in our results.

Similar concern might be raised with respect to China and its weight in North-South relationships. Table (4.7) shows that the results we obtained by interacting disciplines with development levels remain the same after we single out China from the North-South interacted terms.

4.6.2 Simultaneity concerns

We now address the concerns of endogenous trade agreements. As already mentioned in the data description section, the use of announcements (instead of

actual disbursements) reduces the scope for endogeneity. The delay between announcements and actual disbursements (that amounts to two years on average) implies that regressing announcements on PTAs at time t is equivalent to regressing actual FDI on PTAs at time $t-2$ on average, which is a common modification undertaken in the empirical literature. The lag between dependent and independent variables reduces the scope for investors to influence the content of PTAs.

Nevertheless, the two-year lag is an average and is not directly reported by fDi markets, leaving room for some endogeneity concerns due to simultaneity. The main concern is that influential investors might still lobby for specific content in a particular PTA. We can test whether the presence of "big players" drives our main results. There are two possibilities to consider, i) firms might not be organized and only the biggest will engage in lobbying for trade policies, and ii) firms are organized and are represented by lobbyists at the industry-level. We can test these two hypotheses thanks to the project-level information available for our investment data.

For the first scenario, we proxy big firms by those having the largest aggregated announcements across the period at the country pair level. We argue that removing the top one percent should leave the effect of PTAs exogenous to the remaining smaller firms. Table (4.8) confirms that our baseline and discipline level results are robust to removing the top 1 percent of announcements.

We then move to the industry level lobbying hypothesis. To determine which industries lobby most for trade-related issues, we rely on the US Lobbying Disclosure Act of 1995, which requires any lobbying activities engaged within the US to

be disclosed.[11] The Center for Responsive Politics publishes the full reports of the disclosed lobbying activities indicating the client name (including foreign entities), lobbyist name, contribution level and year, and more interestingly industry classification and the general issue that is lobbied for. Among the possible lobbied issues, we focus on the ones that might relate to the content of PTAs, including: tariffs, trade, labor antitrust and workplace, environment, copyright patent and trademark. Table (4.9) gives the level of contributions of each lobbied issue by sector and relative to the sector-level total contribution in 2003. The sectors that are relatively more engaged in PTA-related lobbying turn out to be Health, Construction and Defense. Table (4.10) shows that our results are robust to removing these three lobbying intensive sectors from our estimation sample.

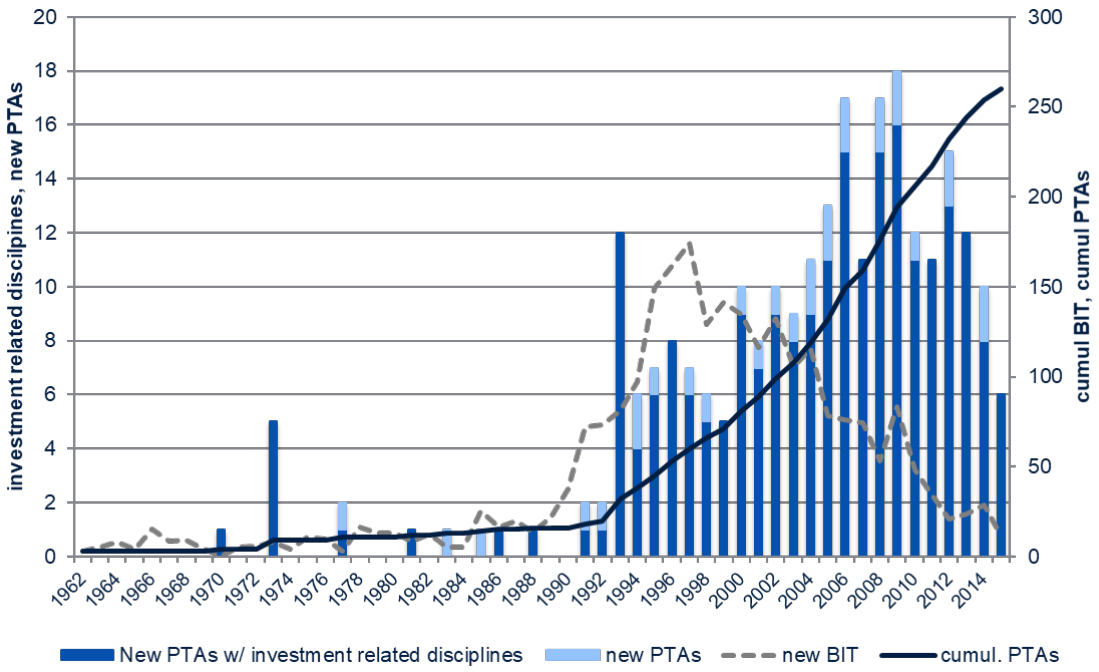
4.7 Conclusion

This paper contributes to the existing literature on the relationship between PTAs and FDI. Our baseline results show that on average adding a discipline to a deep PTA increases FDI by 1.4 percent. In general, WTO-extra disciplines matter more for FDI than WTO-plus. All our disciplines of interest (Investment, IPR, Visa and Asylum, Movement of Capital, Competition policy, Labor market regulations and Environmental laws) promote FDI in service-related activities. Concerning production-related activities, only visa and asylum has a positive and significant impact on FDI, while the inclusion of Labor market regulations and Environmental

[11]The US Lobbying Disclosure Act of 1995 contributes to the "public awareness of the efforts of paid lobbyist to influence the public decision making process in both the legislative and executive branches of the Federal Government"

laws reduces FDI. We also find that discipline level results are mostly driven by investments between developed and developing countries, where the institutional gap is the widest. Finally, we address causality concerns by ruling out the potential influence of lobbying activities at both the firm and industry levels.

4.8 Figures



Sources: Author's calculation based on content of trade agreement database

Figure 4.1: BITs and investment related disciplines in PTAs

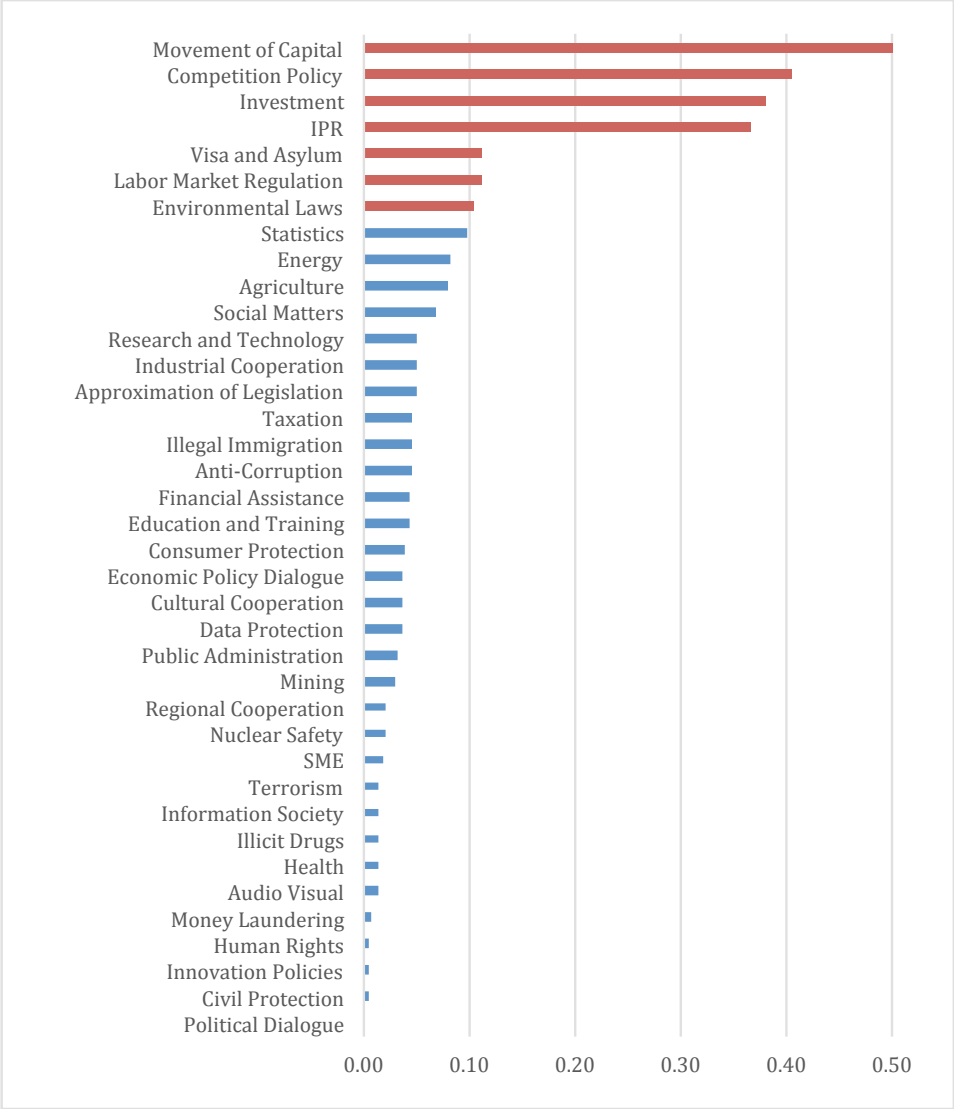


Figure 4.2: Frequency of inclusion of investment related disciplines in PTAs

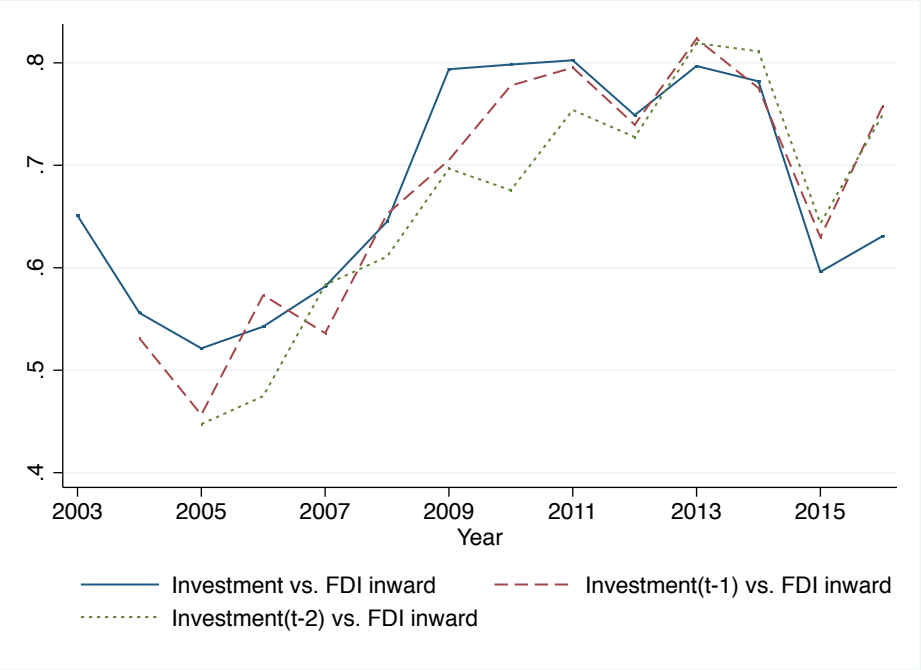


Figure 4.3: Correlation between fDi markets and UNCTAD bilateral investment data

4.9 Tables

18 Business Activities	39 Industries	
Business Services	Aerospace	Hotels & Tourism
Construction	Alternative/Renewable energy	Industrial Machinery, Equipment & Tools
Customer Contact Centre	Automotive Components	Leisure & Entertainment
Design, Development & Testing	Automotive OEM	Medical Devices
Education & Training	Beverages	Metals
Electricity	Biotechnology	Minerals
Extraction	Building & Construction Materials	Non-Automotive Transport OEM
Headquarters	Business Machines & Equipment	Paper, Printing & Packaging
ICT & Internet Infrastructure	Business Services	Pharmaceuticals
Logistics, Distribution & Transportation	Ceramics & Glass	Plastics
Maintenance & Servicing	Chemicals	Real Estate
Production[a]	Coal, Oil and Natural Gas	Rubber
Recycling	Communications	Semiconductors
Research & Development	Consumer Electronics	Software & IT services
Retail	Consumer Products	Space & Defense
Sales, Marketing & Support	Electronic Components	Textiles
Shared Services Centre	Engines & Turbines	Transportation
Technical Support Centre	Financial Services	Warehousing & Storage
	Food & Tobacco	Wood Products
	Healthcare	

Table 4.1: Business activities and industries included in the classification of fDi Markets

[a] fDi markets uses the term "manufacturing", in order to avoid any confusion with the traditional meaning of manufacturing in the trade and investment literature, we decided to replace it by "production" which describes the activity in terms of the tasks performed rather than its industrial sector.

VARIABLES	OLS log(FDI announcements)				PPML FDI announcements	
	(1)	(2)	(3)	(4)	(5)	(6)
PTA	0.0345	0.0664	-0.0823	0.173	-0.205	-0.174
	(0.0699)	(0.0877)	(0.126)	(0.264)	(0.130)	(0.243)
expired PTA		0.100	0.146	0.192	0.174	0.179
		(0.125)	(0.128)	(0.137)	(0.175)	(0.181)
BIT		-0.00306	0.00985	0.00132	-0.109	-0.110
		(0.0661)	(0.0668)	(0.0670)	(0.0684)	(0.0689)
Total Depth			0.00868*		0.0143**	
			(0.00524)		(0.00578)	
WTO-X				0.0163*		0.0155*
				(0.00857)		(0.00865)
WTO-plus				-0.0190		0.0107
				(0.0254)		(0.0233)
Observations	33,622	33,622	33,622	33,622	109,383	109,383
R-squared	0.619	0.619	0.619	0.619	0.800	0.800
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Business activities	All	All	All	All	All	All

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.2: Impact of total depth on investment

VARIABLES	PPML FDI announcements (1)	(2)
Total depth	0.0142**	
	(0.00577)	
Total depth × extraction	0.00873	
	(0.0128)	
WTO-X		0.0169*
		(0.00878)
WTO-plus		0.00765
		(0.0235)
WTO-X × extraction		-0.0145
		(0.0568)
WTO-plus × extraction		0.0229
		(0.0397)
BIT	-0.109	-0.111
	(0.0684)	(0.0689)
PTA	-0.217*	-0.167
	(0.132)	(0.243)
expired PTA	0.167	0.174
	(0.175)	(0.180)
Observations	109,383	109,383
R-squared	0.800	0.800
Country-pair FE	Yes	Yes
Country-time FE	Yes	Yes
Business activities	All	All

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.3: FDI in extractive activities are not driven by PTAs

VARIABLES	Dependent variable: FDI announcements, PPML estimation						
xyz disciplines:	Investment	IPR	Visa and asylum	Environment laws	Labor market regulations	Movement of capital	Competition policy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total depth (xyz exculded)	0.0116*	0.00690	0.00111	0.0272***	0.0366***	0.0136*	0.0192***
	(0.00691)	(0.00648)	(0.00743)	(0.00827)	(0.00653)	(0.00727)	(0.00708)
xyz discipline	0.224	0.361***	0.430***	-0.302	-0.818***	0.0665	-0.142
	(0.210)	(0.130)	(0.143)	(0.188)	(0.145)	(0.181)	(0.221)
Observations	103,953	103,953	103,953	103,953	103,953	103,953	103,953
R-squared	0.799	0.800	0.800	0.799	0.801	0.799	0.799
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business activities	P&S	P&S	P&S	P&S	P&S	P&S	P&S

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.4: Disciplines level estimations

VARIABLES	Dependent variable: FDI announcements, PPML estimation						
xyz disciplines:	Investment	IPR	Visa and asylum	Environment laws	Labor market regulations	Movement of capital	Competition policy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total depth (xyz discipline excluded)	0.0115*	0.00723	0.000498	0.0270***	0.0362***	0.0139*	0.0192***
	(0.00690)	(0.00646)	(0.00748)	(0.00821)	(0.00654)	(0.00731)	(0.00718)
xyz discipline	0.0402	0.178	0.260	-0.485**	-1.100***	-0.119	-0.307
	(0.226)	(0.152)	(0.167)	(0.195)	(0.194)	(0.196)	(0.242)
xyz discipline × service	0.340**	0.345**	0.321*	0.372**	0.511**	0.367**	0.334**
	(0.158)	(0.171)	(0.177)	(0.185)	(0.256)	(0.174)	(0.162)
Observations	103,953	103,953	103,953	103,953	103,953	103,953	103,953
R-squared	0.800	0.801	0.800	0.800	0.801	0.800	0.800
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business activities	P&S	P&S	P&S	P&S	P&S	P&S	P&S

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.5: Disciplines level estimations interacted with services

VARIABLES	Dependent variable: FDI announcements, PPML estimation							
xyz disciplines:	Total depth	Investment	IPR	Visa and asylum	Environment laws	Labor market regulations	Movement of capital	Competition policy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total depth (without xyz)		0.00534	0.00256	0.0248***	0.0371***	0.0125*	0.0145**	0.0235***
		(0.00680)	(0.00797)	(0.00840)	(0.00659)	(0.00729)	(0.00583)	(0.00744)
discipline*South-South	-0.00837	-0.108	-0.229	0.683	-0.784	-0.353	0.178	0.333
	(0.02190)	(0.38000)	(0.31100)	(0.52500)	(0.53900)	(0.45100)	(0.27200)	(0.28400)
discipline*North-North	-0.00184	0.0947	0.0914	-0.561***	-0.793***	-0.415**	-0.0515	-0.699***
	(0.00693)	(0.13200)	(0.29900)	(0.21400)	(0.16600)	(0.20500)	(0.10100)	(0.25300)
discipline*South/North	0.0244***	0.786***	0.489***	-0.0235	-0.884***	0.388**	0.705***	0.0433
	(0.00663)	(0.17900)	(0.14300)	(0.19400)	(0.17200)	(0.18600)	(0.15200)	(0.22700)
Observations	103,953	103,953	103,953	103,953	103,953	103,953	103,953	103,953
R-squared	0.8	0.801	0.8	0.8	0.801	0.801	0.801	0.8
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business activities	P&S	P&S	P&S	P&S	P&S	P&S	P&S	P&S

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.6: Disciplines effects by level of development

VARIABLES	Dependent variable: FDI announcements, PPML estimation							
xyz disciplines:	Total depth	Investment	IPR	Visa and asylum	Environment laws	Labor market regulations	Movement of capital	Competition policy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total depth without discipline		0.00521	0.00194	0.0250***	0.0374***	0.0277***	0.0125*	0.0234***
		-0.00685	-0.00801	-0.00854	-0.00662	-0.0088	-0.00729	-0.00746
Discipline*HH	-0.00154	0.0992	0.112	-0.563***	-0.794***	-0.838***	-0.391	-0.700***
	-0.00693	-0.133	-0.303	-0.215	-0.166	-0.203	-0.467	-0.253
Discipline*LL(with China)	0.0514	0.586	0.252	-	-	0.0445	-0.413**	-
	-0.0431	-0.514	-1.247	-	-	-0.504	-0.205	
Discipline*LL(without China)	-0.0153	-0.271	-0.264	0.676	-0.809	0.585	-0.148	0.334
	-0.0239	-0.483	-0.305	-0.528	-0.538	-1.346	-0.41	-0.284
Discipline*LH(with China)	-0.00254	0.553***	0.0434	0.0609	0.341	0.391**	-0.195	-0.0567
	-0.0146	-0.187	-0.183	-0.189	-0.412	-0.186	-0.269	-0.243
Discipline*LH(without China)	0.0416*	1.068**	0.851***	-0.707	-0.109	-3.002***	0.919**	-0.286
	-0.0224	-0.486	-0.272	-0.495	-0.526	-0.574	-0.421	-0.271
Observations	103,953	103,953	103,953	103,953	103,953	103,953	103,953	103,953
R-squared	0.801	0.801	0.8	0.8	0.801	0.801	0.802	0.8
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business activities	P&S	P&S	P&S	P&S	P&S	P&S	P&S	P&S

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.7: Interaction with China in North-South agreements

VARIABLES	Dependent variable: FDI announcements, PPML estimation							
xyz disciplines:	Total depth	Investment	IPR	Visa and asylum	Environment laws	Labor market regulations	Movement of capital	Competition policy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total depth (d excluded)		0.0079	0.00289	-0.00438	0.0221***	0.0256***	0.00734	0.0120*
		-0.00609	-0.00665	-0.00751	-0.0085	-0.00667	-0.00746	-0.00717
Discipline(d)	0.000947	-0.0527	0.0652	0.206	-0.605***	-0.966***	-0.124	-0.328
	-0.00708	-0.13	-0.147	-0.162	-0.19	-0.207	-0.211	-0.225
Discipline(d)* services	0.0135**	0.283**	0.370**	0.333**	0.502***	0.549**	0.370**	0.416***
	-0.00605	-0.136	-0.165	-0.156	-0.172	-0.237	-0.161	-0.149
Observations	103,941	103,941	103,941	103,941	103,941	103,941	103,941	103,941
R-squared	0.805	0.805	0.806	0.805	0.806	0.806	0.806	0.806
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business activities	P&S	P&S	P&S	P&S	P&S	P&S	P&S	P&S

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.8: Robustness check: removing top 1 percent of projects announcements

General issue	Sector	Contribution	Sector percentage
Copyright, Patent & Trademark	Health	$39,800,000	16%
Copyright, Patent & Trademark	Transportation	$8,730,704	6%
Copyright, Patent & Trademark	Construction	$1,835,212	5%
Environment & Superfund	Defense	$9,905,470	4%
Environment & Superfund	Energy/Nat Resource	$7,355,459	4%
Environment & Superfund	Construction	$1,139,960	3%
Labor, Antitrust & Workplace	Defense	$6,871,012	3%
Labor, Antitrust & Workplace	Construction	$1,202,697	3%
Labor, Antitrust & Workplace	Labor	$1,068,717	2%
Tariffs	Defense	$6,130,000	3%
Tariffs	Health	$5,488,536	2%
Tariffs	Transportation	$2,516,683	2%
Trade	Health	$28,900,000	12%
Trade	Defense	$17,400,000	8%
Trade	Transportation	$7,459,139	5%

Table 4.9: Lobbying contributions by issues

VARIABLES	Dependent variable: FDI announcements, PPML estimation							
xyz disciplines:	Total depth	Investment	IPR	Visa and asylum	Environment laws	Labor market regulations	Movement of capital	Competition policy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total depth (without xyz)		0.0138**	0.00698	-0.000181	0.0257***	0.0360***	0.0134*	0.0193***
		-0.00603	-0.00657	-0.0077	-0.00841	-0.00667	-0.00741	-0.00729
xyz discipline	0.00777	-0.0254	0.18	0.278	-0.454**	-1.112***	-0.106	-0.317
	-0.00764	-0.14	-0.159	-0.174	-0.206	-0.213	-0.201	-0.248
xyz discipline × services	0.0128*	0.332**	0.358**	0.312*	0.371*	0.529*	0.372**	0.344**
	-0.00675	-0.154	-0.178	-0.183	-0.195	-0.272	-0.182	-0.169
Observations	101,526	101,526	101,526	101,526	101,526	101,526	101,526	101,526
R-squared	0.799	0.799	0.8	0.799	0.799	0.801	0.799	0.799
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business activities	P&S	P&S	P&S	P&S	P&S	P&S	P&S	P&S

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.10: robustness check: removing lobbying intensive sectors

Table 4.11: Industries and business activities partitioning

Sector: outstanding % row total % column total	Activities																	
	Extraction	Production	Business Services	Construction	Customer Contact Center	Design, Development & Testing	Education & Training	Electricity	Headquarters	ICT & Internet Infrastructure	Logistics, Distribution & Transportation	Maintenance & Servicing	Recycling	Research & Development	Retail	Sales, Marketing & Support	Shared Services Center	Technical Support Center
	-	46,677	157	-	58	9,034	2,313	-	4,265	-	1,820	10,097	2	567	-	2,866	22	1
Aerospace	-	59.9	0.2	-	0.1	11.6	3.0	-	5.5	-	2.3	13.0	0.0	0.7	-	3.7	0.0	0.0
	-	1.2	0.0	-	0.3	4.2	8.4	-	2.6	-	0.3	37.9	0.0	0.5	-	0.6	0.1	0.0
Alternative	-	52,281	48	-	12	478	48	513,332	1,239	-	508	107	204	1,059	519	56,056	-	2
& Renewable	-	8.4	0.0	-	0.0	0.1	0.0	82.0	0.2	-	0.1	0.0	0.0	0.2	0.1	9.0	-	0.0
energy	-	1.3	0.0	-	0.1	0.2	0.2	53.4	0.8	-	0.1	0.4	0.6	1.0	0.1	12.3	-	0.0
Automotive	-	232,371	-	-	43	8,329	459	-	3,934	-	5,119	739	50	3,054	771	1,236	110	107
Components	-	90.7	-	-	0.0	3.2	0.2	-	1.5	-	2.0	0.3	0.0	1.2	0.3	0.5	0.0	0.0
	-	5.8	-	-	0.3	3.9	1.7	-	2.4	-	0.8	2.8	0.2	2.9	0.1	0.3	0.7	0.7
Automotive OEM	-	504,999	103	-	60	18,667	2,120	-	6,413	435	2,429	1,882	157	7,166	8,289	4,375	73	118
(Original Equipment	-	90.6	0.0	-	0.0	3.3	0.4	-	1.2	0.1	0.4	0.3	0.0	1.3	1.5	0.8	0.0	0.0
Manufacturer)	-	12.6	0.0	-	0.4	8.7	7.7	-	3.9	0.1	0.4	7.1	0.5	6.9	1.3	1.0	0.5	0.8
	137	54,786	110	-	13	176	16	-	1,186	-	2,443	-	4	349	1,270	4,577	91	-
Beverages	0.2	84.1	0.2	-	0.0	0.3	0.0	-	1.8	-	3.7	-	0.0	0.5	1.9	7.0	0.1	-
	0.0	1.4	0.0	-	0.1	0.1	0.1	-	0.7	-	0.4	-	0.0	0.3	0.2	1.0	0.6	-
	-	19,054	76	-	18	801	69	-	1,385	-	205	10	-	9,345	-	1,112	4	12
Biotechnology	-	59.4	0.2	-	0.1	2.5	0.2	-	4.3	-	0.6	0.0	-	29.1	-	3.5	0.0	0.0
	-	0.5	0.0	-	0.1	0.4	0.3	-	0.8	-	0.0	0.0	-	9.0	-	0.2	0.0	0.1
Building	-	128,699	-	-	-	264	25	-	533	63	998	-	8	43	973	68	6	-
& Construction	-	97.7	-	-	-	0.2	0.0	-	0.4	0.0	0.8	-	0.0	0.0	0.7	0.1	0.0	-
Materials	-	3.2	-	-	-	0.1	0.1	-	0.3	0.0	0.2	-	0.0	0.0	0.2	0.0	0.0	-
Business	-	40,457	254	-	511	3,947	331	-	4,391	446	1,105	879	784	1,583	529	1,492	2,013	1,781
Machines	-	66.9	0.4	-	0.8	6.5	0.5	-	7.3	0.7	1.8	1.5	1.3	2.6	0.9	2.5	3.3	2.9
& Equipment	-	1.0	0.0	-	3.0	1.8	1.2	-	2.7	0.1	0.2	3.3	2.4	1.5	0.1	0.3	12.7	11.5
Business	-	275	108,157	41,434	5,300	4,098	11,939	-	7,665	2,306	443	142	23,981	1,657	5,097	42	3,627	1,544
Services	-	0.1	49.7	19.0	2.4	1.9	5.5	-	3.5	1.1	0.2	0.1	11.0	0.8	2.3	0.0	1.7	0.7
	-	0.0	18.5	2.9	31.4	1.9	43.3	-	4.7	0.5	0.1	0.5	72.1	1.6	0.8	0.0	23.0	9.9
Ceramics	-	45,892	-	-	47	72	2	-	477	-	542	93	34	25	2,555	139	21	-
& Glass	-	92.0	-	-	0.1	0.1	0.0	-	1.0	-	1.1	0.2	0.1	0.1	5.1	0.3	0.0	-
	-	1.1	-	-	0.3	0.0	0.0	-	0.3	-	0.1	0.3	0.1	0.0	0.4	0.0	0.1	-
	2,142	480,193	63	-	24	4,959	646	-	4,179	-	6,470	272	430	4,904	1,058	5,063	269	193
Chemicals																		

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Table 4.11 – *Continued from previous page*

Sector: outstanding / % row total / % column total	Activities																	
	Extraction	Production	Business Services	Construction	Customer Contact Center	Design, Development & Testing	Education & Training	Electricity	Headquarters	ICT & Internet Infrastructure	Logistics, Distribution & Transportation	Maintenance & Servicing	Recycling	Research & Development	Retail	Sales, Marketing & Support	Shared Services Center	Technical Support Center
	0.4	94.0	0.0	-	0.0	1.0	0.1	-	0.8	-	1.3	0.1	0.1	1.0	0.2	1.0	0.1	0.0
	0.2	12.0	0.0	-	0.1	2.3	2.3	-	2.5	-	1.1	1.0	1.3	4.7	0.2	1.1	1.7	1.2
Coal, Oil and Natural Gas	661,085	596,779	1,452	-	207	1,541	487	448,845	2,655	672	51,942	384	343	3,418	10,929	16,224	1,211	1
	36.8	33.2	0.1	-	0.0	0.1	0.0	25.0	0.1	0.0	2.9	0.0	0.0	0.2	0.6	0.9	0.1	0.0
	66.5	14.9	0.2	-	1.2	0.7	1.8	46.6	1.6	0.2	8.6	1.4	1.0	3.3	1.7	3.6	7.7	0.0
	-	35,025	922	-	3,130	46,282	1,092	-	15,928	363,192	4,090	833	154	8,624	4,153	20,848	1,275	1,859
Communications	-	6.9	0.2	-	0.6	9.1	0.2	-	3.1	71.6	0.8	0.2	0.0	1.7	0.8	4.1	0.3	0.4
	-	0.9	0.2	-	18.6	21.6	4.0	-	9.7	83.2	0.7	3.1	0.5	8.3	0.6	4.6	8.1	12.0
Consumer Electronics	-	45,436	18	-	161	1,905	562	-	2,920	-	1,571	390	541	3,070	10,966	2,467	68	142
	-	64.7	0.0	-	0.2	2.7	0.8	-	4.2	-	2.2	0.6	0.8	4.4	15.6	3.5	0.1	0.2
	-	1.1	0.0	-	1.0	0.9	2.0	-	1.8	-	0.3	1.5	1.6	3.0	1.7	0.5	0.4	0.9
Consumer Products	-	32,816	28	-	454	1,454	129	-	4,422	-	23,298	111	18	1,088	211,751	5,021	151	48
	-	11.7	0.0	-	0.2	0.5	0.0	-	1.6	-	8.3	0.0	0.0	0.4	75.4	1.8	0.1	0.0
	-	0.8	0.0	-	2.7	0.7	0.5	-	2.7	-	3.8	0.4	0.1	1.1	32.7	1.1	1.0	0.3
Electronic Components	-	199,482	57	-	38	7,379	440	-	12,939	120	1,975	486	496	2,442	883	4,121	86	209
	-	86.3	0.0	-	0.0	3.2	0.2	-	5.6	0.1	0.9	0.2	0.2	1.1	0.4	1.8	0.0	0.1
	-	5.0	0.0	-	0.2	3.4	1.6	-	7.9	0.0	0.3	1.8	1.5	2.4	0.1	0.9	0.5	1.3
Engines & Turbines	-	33,516	21	-	18	2,307	80	-	838	-	437	422	-	664	-	1,275	125	12
	-	84.4	0.1	-	0.0	5.8	0.2	-	2.1	-	1.1	1.1	-	1.7	-	3.2	0.3	0.0
	-	0.8	0.0	-	0.1	1.1	0.3	-	0.5	-	0.1	1.6	-	0.6	-	0.3	0.8	0.1
Financial Services	-	-	415,908	-	2,239	1,170	712	-	19,204	4,043	713	-	-	141	8	69,453	1,895	728
	-	-	80.6	-	0.4	0.2	0.1	-	3.7	0.8	0.1	-	-	0.0	0.0	13.5	0.4	0.1
	-	-	71.1	-	13.3	0.5	2.6	-	11.7	0.9	0.1	-	-	0.1	0.0	15.3	12.0	4.7
Food & Tobacco	-	169,263	238	-	132	1,450	222	-	5,389	-	27,106	38	17	2,011	171,624	6,284	336	21
	-	44.1	0.1	-	0.0	0.4	0.1	-	1.4	-	7.1	0.0	0.0	0.5	44.7	1.6	0.1	0.0
	-	4.2	0.0	-	0.8	0.7	0.8	-	3.3	-	4.5	0.1	0.1	1.9	26.5	1.4	2.1	0.1
	-	195	1,378	16,501	14	434	130	-	276	-	-	-	-	939	17	686	12	-
Healthcare	-	0.9	6.7	80.2	0.1	2.1	0.6	-	1.3	-	-	-	-	4.6	0.1	3.3	0.1	-
	-	0.0	0.2	1.1	0.1	0.2	0.5	-	0.2	-	-	-	-	0.9	0.0	0.2	0.1	-
Hotels & Tourism	-	-	4	346,737	202	109	143	-	2,031	-	-	-	-	-	603	1,215	84	-
	-	-	0.0	98.7	0.1	0.0	0.0	-	0.6	-	-	-	-	-	0.2	0.3	0.0	-
	-	-	0.0	24.0	1.2	0.1	0.5	-	1.2	-	-	-	-	-	0.1	0.3	0.5	-

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Table 4.11 – *Continued from previous page*

Sector: outstanding / % row total / % column total	Activities																	
	Extraction	Production	Business Services	Construction	Customer Contact Center	Design, Development & Testing	Education & Training	Electricity	Headquarters	ICT & Internet Infrastructure	Logistics, Distribution & Transportation	Maintenance & Servicing	Recycling	Research & Development	Retail	Sales, Marketing & Support	Shared Services Center	Technical Support Center
Industrial Machinery,	-	111,920	232	-	101	8,880	1,605	6	10,647	204	5,318	2,827	316	2,152	305	9,024	597	383
Equipment	-	72.4	0.2	-	0.1	5.7	1.0	0.0	6.9	0.1	3.4	1.8	0.2	1.4	0.2	5.8	0.4	0.2
& Tools	-	2.8	0.0	-	0.6	4.2	5.8	0.0	6.5	0.0	0.9	10.6	0.9	2.1	0.0	2.0	3.8	2.5
Leisure	-	41	141	52,939	3	66	198	-	417	320	-	-	-	-	30,799	1,272	-	-
& Entertainment	-	0.0	0.2	61.4	0.0	0.1	0.2	-	0.5	0.4	-	-	-	-	35.7	1.5	-	-
	-	0.0	0.0	3.7	0.0	0.0	0.7	-	0.3	0.1	-	-	-	-	4.8	0.3	-	-
Medical	-	19,987	314	-	21	2,507	762	-	2,613	-	1,680	170	-	3,975	168	1,641	192	45
Devices	-	58.7	0.9	-	0.1	7.4	2.2	-	7.7	-	4.9	0.5	-	11.7	0.5	4.8	0.6	0.1
	-	0.5	0.1	-	0.1	1.2	2.8	-	1.6	-	0.3	0.6	-	3.8	0.0	0.4	1.2	0.3
	307,344	489,236	94	-	7	744	124	-	2,051	73	7,082	1,258	3,043	1,154	536	2,456	2	47
Metals	37.7	60.0	0.0	-	0.0	0.1	0.0	-	0.3	0.0	0.9	0.2	0.4	0.1	0.1	0.3	0.0	0.0
	30.9	12.2	0.0	-	0.0	0.3	0.5	-	1.2	0.0	1.2	4.7	9.1	1.1	0.1	0.5	0.0	0.3
	22,762	7,365	17	-	-	814	314	-	244	-	138	-	40	20	313	194	-	-
Minerals	70.6	22.9	0.1	-	-	2.5	1.0	-	0.8	-	0.4	-	0.1	0.1	1.0	0.6	-	-
	2.3	0.2	0.0	-	-	0.4	1.1	-	0.1	-	0.0	-	0.1	0.0	0.0	0.0	-	-
Non-Automotive	-	35,218	167	-	-	504	204	-	217	-	2,400	3,732	209	284	1,607	858	18	-
Transport OEM	-	77.5	0.4	-	-	1.1	0.4	-	0.5	-	5.3	8.2	0.5	0.6	3.5	1.9	0.0	-
	-	0.9	0.0	-	-	0.2	0.7	-	0.1	-	0.4	14.0	0.6	0.3	0.2	0.2	0.1	-
Paper,	-	110,310	53	-	18	570	26	-	187	-	2,004	100	1,196	126	29	476	46	-
Printing	-	95.8	0.0	-	0.0	0.5	0.0	-	0.2	-	1.7	0.1	1.0	0.1	0.0	0.4	0.0	-
& Packaging	-	2.7	0.0	-	0.1	0.3	0.1	-	0.1	-	0.3	0.4	3.6	0.1	0.0	0.1	0.3	-
	-	76,207	425	-	1	5,109	195	-	6,750	383	2,497	-	-	22,613	898	5,312	876	19
Pharmaceuticals	-	62.8	0.4	-	0.0	4.2	0.2	-	5.6	0.3	2.1	-	-	18.6	0.7	4.4	0.7	0.0
	-	1.9	0.1	-	0.0	2.4	0.7	-	4.1	0.1	0.4	-	-	21.8	0.1	1.2	5.5	0.1
	-	95,523	21	-	3	2,653	132	-	2,369	-	787	91	721	550	201	744	14	30
Plastics	-	92.0	0.0	-	0.0	2.6	0.1	-	2.3	-	0.8	0.1	0.7	0.5	0.2	0.7	0.0	0.0
	-	2.4	0.0	-	0.0	1.2	0.5	-	1.4	-	0.1	0.3	2.2	0.5	0.0	0.2	0.1	0.2
	-	719	32,129	987,122	-	160	11	-	621	-	3,642	1	-	-	238	33,917	70	-
Real Estate	-	0.1	3.0	93.2	-	0.0	0.0	-	0.1	-	0.3	0.0	-	-	0.0	3.2	0.0	-
	-	0.0	5.5	68.3	-	0.1	0.0	-	0.4	-	0.6	0.0	-	-	0.0	7.5	0.4	-
	-	87,490	-	-	8	1,387	2	-	712	-	1,167	353	471	424	1,123	514	194	-
Rubber	-	93.2	-	-	0.0	1.5	0.0	-	0.8	-	1.2	0.4	0.5	0.5	1.2	0.5	0.2	-

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Table 4.11 – *Continued from previous page*

Sector: outstanding / % row total / % column total	Activities																	
	Extraction	Production	Business Services	Construction	Customer Contact Center	Design, Development & Testing	Education & Training	Electricity	Headquarters	ICT & Internet Infrastructure	Logistics, Distribution & Transportation	Maintenance & Servicing	Recycling	Research & Development	Retail	Sales, Marketing & Support	Shared Services Center	Technical Support Center
	-	2.2	-	-	0.0	0.6	0.0	-	0.4	-	0.2	1.3	1.4	0.4	0.2	0.1	1.2	-
	-	174,354	41	-	14	16,238	127	-	6,365	142	773	112	-	9,424	27	2,048	46	142
Semiconductors	-	83.1	0.0	-	0.0	7.7	0.1	-	3.0	0.1	0.4	0.1	-	4.5	0.0	1.0	0.0	0.1
	-	4.3	0.0	-	0.1	7.6	0.5	-	3.9	0.0	0.1	0.4	-	9.1	0.0	0.5	0.3	0.9
Software	-	1,964	21,920	-	3,697	57,763	1,049	-	21,773	63,523	1,575	290	-	10,218	291	81,499	2,076	8,086
& IT services	-	0.7	7.9	-	1.3	20.9	0.4	-	7.9	23.0	0.6	0.1	-	3.7	0.1	29.6	0.8	2.9
	-	0.0	3.7	-	21.9	27.0	3.8	-	13.2	14.6	0.3	1.1	-	9.9	0.0	17.9	13.1	52.0
	-	2,237	37	-	-	1,041	83	-	975	-	53	134	-	129	-	727	22	-
Space	-	41.1	0.7	-	-	19.1	1.5	-	17.9	-	1.0	2.5	-	2.4	-	13.4	0.4	-
& Defence	-	0.1	0.0	-	-	0.5	0.3	-	0.6	-	0.0	0.5	-	0.1	-	0.2	0.1	-
	-	40,342	2	120	53	220	70	-	2,096	-	7,779	305	-	241	175,844	930	21	21
Textiles	-	17.7	0.0	0.1	0.0	0.1	0.0	-	0.9	-	3.4	0.1	-	0.1	77.1	0.4	0.0	0.0
	-	1.0	0.0	0.0	0.3	0.1	0.3	-	1.3	-	1.3	1.1	-	0.2	27.2	0.2	0.1	0.1
	-	169	584	150	259	419	649	-	4,043	637	257,228	385	-	46	891	107,181	141	-
Transportation	-	0.0	0.2	0.0	0.1	0.1	0.2	-	1.1	0.2	69.0	0.1	-	0.0	0.2	28.8	0.0	-
	-	0.0	0.1	0.0	1.5	0.2	2.4	-	2.5	0.1	42.5	1.4	-	0.0	0.1	23.6	0.9	-
Warehousing	-	9,204	-	270	-	-	5	-	235	-	177,685	-	-	-	29	556	1	-
& Storage	-	4.9	-	0.1	-	-	0.0	-	0.1	-	94.5	-	-	-	0.0	0.3	0.0	-
	-	0.2	-	0.0	-	-	0.0	-	0.1	-	29.3	-	-	-	0.0	0.1	0.0	-
Wood	-	32,895	-	-	-	44	31	-	67	-	623	6	52	20	1,539	747	-	-
Products	-	91.3	-	-	-	0.1	0.1	-	0.2	-	1.7	0.0	0.1	0.1	4.3	2.1	-	-
	-	0.8	-	-	-	0.0	0.1	-	0.0	-	0.1	0.0	0.2	0.0	0.2	0.2	-	-

Chapter 5: Conclusion

In light of the rise of offshoring and the expansion of GVCs, [Antràs and Staiger, 2012] make a case for a structural reshaping of PTAs arguing that "effective trade agreements and the institutions that support them will have to evolve, from a market access focus toward a focus on deep integration, and from a reliance on simple and broadly-applied rules that guide the member-governments in their negotiations and shape their agreements, toward a collection of more-individualized agreements that can better reflect member-specific idiosyncratic needs". This structural reshaping calls for an adaptation of the traditional tools used to evaluate the economic impact of PTAs.

This dissertation contributes to this agenda by using theoretical and empirical techniques to study the impact of specific behind-the-border provisions included in PTAs. The different exercises conducted in the three analytical chapters show that modern PTAs have differentiated effects on their members and across sectors. It focuses on the investment and quality impacts of deep PTAs and shows that, at the policy level, PTAs can have positive impacts. To go further, one could study in more details the effects of deep PTAs on welfare with more elaborated quantitative tools. The complexity of the model derived in the second chapter hints that computational

tools would be necessary to solve the general equilibrium problem.

To conclude this thesis, I want to emphasize the importance of leveraging the assets of both multilateral and preferential trading systems. Global trade has been under strain from the year-long trade war between the US and China. Despite the difficulties encountered since its last major round of negotiations, the WTO has a determinant role to play in solving the current trade tensions. Because no other institution has brought more stability to international trade, it is in the interest of all to preserve the multilateral institution. Countries should also continue to seek integration through PTAs, as they have proven to be good alternatives to address behind-the-border issues.

Appendix A: Additional tables and figures

A.1 Tables

Table A.1: List of WTO-plus disciplines included in PTAs

WTO-plus policy areas	
AD	Retention of antidumping rights and obligations under the WTO Agreement (Art VI GATT). Unfair trade practices.
Customs	Provision of information; publication on the internet of new laws and regulations; training. Incl. provisions on trade facilitation.
CVM	Retention of countervailing measures rights and obligations under the WTO Agreement (Art VI GATT).
Export Taxes	Elimination of export taxes. Examples: Elimination of customs duties on exports, elimination of duties, taxes or other charges on exports.
FTA Agriculture	Tariff liberalization with regard to agriculture goods; elimination of non-tariff measures.
FTA Industrial or Customs	Tariff liberalization with regard to industrial goods; elimination of non-tariff measures.
GATS	Liberalization of trade in services.
Public Procurement	Progressive liberalization; national treatment and/or non-discrimination principle; publication of laws and regulations on the internet; specification on public procurement regime.
SPS	Affirmation of rights and obligations under the WTO Agreement on SPS; harmonization of SPS measures.
State Aid	Assessment of anticompetitive behavior; annual reporting on the value and distribution of state aid given; provision of information. Incl. export subsidies on products.

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Table A.1 – *Continued from previous page*

WTO-plus policy areas	
STE	GATT Art. XVII. Establishment or maintenance of a state enterprise in accordance with and affirming provisions of GATT. Non-discrimination regarding production and marketing condition; provision of information. Incl. provisions on public undertakings.
TBT	Affirmation of rights and obligations under WTO Agreement on TBT; provision of information; harmonization of regulations; mutual recognition agreements.
TRIMs	Provisions concerning requirements for local content and export performance on FDI. Applies only to measures that affect trade in goods.
TRIPs	Harmonization of standards; enforcement; national treatment; most-favored nation treatment and any other policy covered by TRIPs. International treaties referenced in TRIPS: Paris Convention, Berne Convention, Rome Convention, IPIC Treaty.

Table A.2: List of WTO-X disciplines included in PTAs

WTO-X policy areas	
Anti-Corruption	Regulations concerning criminal offense measures in matters affecting international trade and investment
Competition Policy	Maintenance of measures to proscribe anticompetitive business conduct; harmonization of competition laws; establishment or maintenance of an independent competition authority
Environmental Laws	Development of environmental standards; enforcement of national environmental laws; establishment of sanctions for violation of environmental laws; publications of laws and regulation
IPR	Accession to international treaties not referenced in the TRIPs Agreement
Investment	Information exchange; Development of legal frameworks; Harmonization and simplification of procedures; National treatment; establishment of mechanism for the settlement of disputes
Labor Market Regulation	Regulation of the national labour market; affirmation of International Labour Organization (ILO) commitments; enforcement
Movement of Capital	Liberalization of capital movement; prohibition of new restrictions
Consumer Protection	Harmonization of consumer protection laws; exchange of information and experts; training
Data Protection	Exchange of information and experts; joint projects
Agriculture	Technical assistance to conduct modernization projects; exchange of information
Approximation of Legislation	Application of EC legislation in national legislation
Audio Visual	Promotion of the industry; encouragement of coproduction
Civil Protection	Implementation of harmonized rules
Innovation Policies	Participation in framework programs; promotion of technology transfers
Cultural Cooperation	Promotion of joint initiatives and local culture
Economic Policy Dialogue	Exchange of ideas and opinions; joint studies
Education and Training	Measures to improve the general level of education
Energy	Exchange of information; technology transfer; joint studies

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Table A.2 – *Continued from previous page*

WTO-X policy areas	
Financial Assistance	Set of rules guiding the granting and administration of financial assistance
Health	Monitoring of diseases; development of health information systems; exchange of information
Human Rights	Respect for human rights
Illegal Immigration	Conclusion of re-admission agreements; prevention and control of illegal immigration
Illicit Drugs	Treatment and rehabilitation of drug addicts; joint projects on prevention of consumption; reduction of drug supply; information exchange
Industrial Cooperation	Assistance in conducting modernization projects; facilitation and access to credit to finance
Information Society	Exchange of information; dissemination of new technologies; training
Mining	Exchange of information and experience; development of joint initiatives
Money Laundering	Harmonization of standards; technical and administrative assistance
Nuclear Safety	Development of laws and regulations; supervision of the transportation of radioactive materials
Political Dialogue	Convergence of the parties? positions on international issues
Public Administration	Technical assistance; exchange of information; joint projects; Training
Regional Cooperation	Promotion of regional cooperation; technical assistance programmes
Research and Technology	Joint research projects; exchange of researchers; development of public-private partnership
SME	Technical assistance for small and medium enterprises; facilitation of the access to finance
Social Matters	Coordination of social security systems; non-discrimination regarding working conditions
Statistics	Harmonization and/or development of statistical methods; training
Taxation	Assistance in conducting fiscal system reforms
Terrorism	Exchange of information and experience; joint research and studies
Visa and Asylum	Exchange of information; drafting legislation; training

Table A.3: Template for TBT chapters' mapping

	Provisions in TBT chapter
	Reference to WTO-TBT agreement:
TBT–1	Does the agreement refer to the WTO TBT Agreement?
TBT–2	Does the agreement use the same definitions as the TBT Agreements?
TBT–3	Does the agreement go beyond the TBT Agreement?
	Integration approach:
TBT–4	Standards: — Is mutual recognition in force?
TBT–5	Standards: — Is there a time schedule for achieving mutual recognition?
TBT–6	Standards: — Is the burden of justifying non-equivalence on the importing country?
TBT–7	Standards: — Is the burden of justifying non-equivalence on the importing country?
TBT–8	Standards: — Is the use or creation of regional standards promoted?
TBT–9	Standards: — Is the use of international standards promoted?
TBT–10	Technical Regulations: — Is mutual recognition in force?
TBT–11	Technical Regulations: — Is there a time schedule for achieving mutual recognition?
TBT–12	Technical Regulations: — Is the burden of justifying non-equivalence on the importing country?
TBT–13	Technical Regulations: — Are there specified existing standards to which countries shall harmonize?
TBT–14	Technical Regulations: — Is the use or creation of regional standards promoted?
TBT–15	Technical Regulations: — Is the use of international standards promoted?
TBT–16	Conformity Assessment: — Is mutual recognition in force?
TBT–17	Conformity Assessment: — Is there a time schedule for achieving mutual recognition?
TBT–18	Conformity Assessment: — Do parties participate in international or regional accreditation agencies?
TBT–19	Conformity Assessment: — Is the burden of justifying non-equivalence on the importing country?
TBT–20	Conformity Assessment: — Are there specified existing standards to which shall harmonize?
TBT–21	Conformity Assessment: — Is the use or creation of regional standards promoted?
TBT–22	Conformity Assessment: — Is the use of international standards promoted?
	Transparency requirements:
TBT–23	Is the time period allowed for comments specified?
TBT–24	Is the time period allowed for comments longer than 60 days?
TBT–25	Contact points/consultations for exchange of information

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Table A.3 – *Continued from previous page*

	Provisions in TBT chapter
	Institutions:
TBT–26	Is a regional body established?
TBT–27	Is there a regional dispute settlement body?
TBT–28	Are there regional consultations foreseen to resolve disputes?
TBT–29	Is there a mechanism to issue recommendations?
TBT–30	Are recommendations mandatory?
TBT–31	Is the recourse to the DS for technical regulations disallowed?
	Further cooperation among members:
TBT–32	Common policy/standardization program (beyond trade-related objectives)
TBT–33	Technical Assistance
TBT–34	Metrology

Table A.4: Template for SPS chapters' mapping

	Provisions in SPS chapter
	Reference to WTO-SPS agreement:
SPS–1	Does the Agreement refer to the WTO SPS Agreement?
SPS–2	Does the Agreement use the same definitions as the SPS Agreement?
SPS–3	Does the Agreement use the same rules as the SPS Agreement?
SPS–4	Are any specific Annexes of the SPS Agreement adopted?
	Integration approach:
SPS–5	Standards: — Do parties recognize the adaption to regional conditions (including regionalization, zoning and/or compartmentalization)
SPS–6	Standards: — Do parties reference international standards?
SPS–7	Standards: — Is equivalence recognized?
SPS–8	Standards: — Are Parties encouraged to take into account other parties' standards when elaborating new standards?
SPS–9	Standards: — Is the burden of justifying non-equivalence on the importing country?
SPS–10	Standards: — Is mutual recognition recognized?
SPS–11	Standards: — Is there a time schedule for achieving mutual recognition?
SPS–12	Standards: — Are there specified existing standards to which countries shall harmonize?
SPS–13	Standards: — Is the creation of concerted/regional standards referenced?
SPS–14	Risk assessment: — Do the parties recognize that SPS measures are based on documented and scientific (if not available, objective) evidence?
SPS–15	Risk assessment: — if yes, length of period (days)
SPS–16	Risk assessment: — Is the burden of evaluating risk on the exporting country?
SPS–17	Risk assessment: — Is there reference to international standards/procedures?
SPS–18	Audits/Control inspection: — Is there a provision on control and inspection?
SPS–19	Audits/Control inspection: — Are there provisions for pre-certification processes for exporting firms?
SPS–20	Audits/Control inspection: — Are there provisions for advance rulings?
SPS–21	Audits/Control inspection: — Is mutual recognition in force?
SPS–22	Audits/Control inspection: — Does the importing party have the right to audit the exporting party's competent authorities, inspection systems, or production procedure?
SPS–23	Audits/Control inspection: — Is the burden of justifying non-equivalence on the importing country?
SPS–24	Audits/Control inspection: — Is the participation of interested parties referenced?
SPS–25	Audits/Control inspection: — Are there specified existing standards to which countries shall harmonize?

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Table A.4 – *Continued from previous page*

	Provisions in SPS chapter
SPS–26	Audits/Control inspection: — Is the use or creation of regional standards promoted?
SPS–27	Audits/Control inspection: — Is the use of international standards promoted?
	Transparency:
SPS–28	Is there a transparency provision?
SPS–29	Is there a provision on exchange of information?
SPS–30	Is there a provision on electronic publication?
SPS–31	Is there a duty to translate the document in the language of the other party(ies)?
SPS–32	Is there a limitation to the obligation to notify, for reasons of law enforcement, public interest, or commercial interest?
SPS–33	Do parties have to notify each other prior to the entry into force of a new standard or regulation?
SPS–34	Is there a specified minimum time period for comments?
SPS–35	Is there a derogation clause on notification period for emergency?
SPS–37	Does the Agreement allow the participation of interested parties of the other party in the development of standards?
SPS–38	Does the agreement specifically reference the participation of regulatory authorities of the other party in the development of standards?
	Institutions:
SPS–39	Do parties establish SPS contact/enquiry points?
SPS–40	Do parties establish a SPS committee?
SPS–41	Is there a fixed periodical meeting for the committee?
SPS–42	Is the SPS Committee the designated first place for dispute resolution?
SPS–43	Is the SPS Committee open?
SPS–44	Do parties establish a working group?
SPS–45	Is there a mechanism to issue recommendations?
SPS–46	Is there a mechanism mandated to issue administrative decisions?
SPS–47	Is a body for administering the Agreement established?
SPS–48	Is the recourse to the DS for SPS chapter disallowed?
	International Regulatory cooperation areas:
SPS–49	Is there a general IRC clause/Common policy/standardization program (beyond trade-related objectives)?
SPS–50	Is there a provision on technical assistance?
SPS–51	Is there a provision for technical consultations/cooperation?
	Other areas of cooperation:
SPS–52	Is there an MRA in force?
SPS–53	Is there a provision on special/preferential treatment?
SPS–54	Is there a provision on certifications?
SPS–55	Is there a provision on labelling, marking, and packaging?
SPS–56	Is there a provision on traceability?

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Table A.4 – *Continued from previous page*

	Provisions in SPS chapter
SPS–57	Is coordination for participating in international or regional accreditation agencies referenced?
SPS–58	Is testing data to be made available?

	ln(*quality*)					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
$TBT^{MutualReco}_{Standard}$	0.361***					
	(0.0685)					
$TBT^{MutualReco}_{TechReg}$		0.361***				
		(0.0685)				
$TBT^{MutualReco}_{Conformity}$			0.354***			
			(0.0610)			
$TBT^{Harmo}_{Standard}$				0.191***		
				(0.0572)		
$TBT^{Harmo}_{TechReg}$					0.227***	
					(0.0566)	
$TBT^{Harmo}_{Conformity}$						0.198***
						(0.0557)
$TotalDepth$	0.00802***	0.00802***	0.00813***	0.00655***	0.00695***	0.00669***
	(0.00128)	(0.00128)	(0.00126)	(0.00124)	(0.00124)	(0.00124)
Observations	3,196,883	3,196,883	3,196,883	3,196,883	3,196,883	3,196,883
R-squared	0.030	0.030	0.030	0.030	0.030	0.030
Origin-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes	Yes	Yes
HS2 FE	No	No	No	No	No	No
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.5: Baseline estimation of the impact of TBT provisions on average quality without sector fixed effects

	ln(*quality*)			
VARIABLES	(1)	(2)	(3)	(4)
$SPS^{MutualReco}_{Standard}$	0.0629			
	(0.131)			
$SPS^{MutualReco}_{Inspection}$		0.171		
		(0.115)		
$SPS^{Harmo}_{Standard}$			0.324*	
			(0.179)	
$SPS^{Harmo}_{Inspection}$				-0.115**
				(0.0499)
$TotalDepth$	0.00354***	0.00349***	0.00357***	0.00470***
	(0.00120)	(0.00120)	(0.00120)	(0.00126)
Observations	667,361	667,361	667,361	667,361
R-squared	0.041	0.041	0.041	0.041
Origin-time FE	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.6: Baseline estimation of the impact of TBT provisions on average quality without sector fixed effects

VARIABLES	$\ln(quality)$	
	(1)	(2)
$TBT_{all}^{MutualReco}(t-2) \times NorthNorth$	-0.175***	
	(0.0678)	
$TBT_{all}^{MutualReco}(t-2) \times NorthSouth$	0.220*	
	(0.122)	
$TBT_{all}^{MutualReco}(t-2) \times SouthSouth$	0.725***	
	(0.234)	
$TBT_{all}^{Harmo}(t-2) \times NorthNorth$		-0.106
		(0.0745)
$TBT_{all}^{Harmo}(t-2) \times NorthSouth$		0.152**
		(0.0717)
$TBT_{all}^{Harmo}(t-2) \times SouthSouth$		0.0729
		(0.220)
$TotalDepth$	0.00274**	0.00309**
	(0.00136)	(0.00137)
Observations	2,543,354	2,543,354
R-squared	0.492	0.492
Origin-time FE	Yes	Yes
Destination-time FE	Yes	Yes
HS2 FE	Yes	Yes
pair FE	yes	yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.7: TBT lagged interaction with level of development

VARIABLES	$\ln(quality)$	
	(1)	(2)
$SPS_{all}^{MutualReco}(t-2) \times NorthNorth$	0.0947	
	(0.263)	
$SPS_{all}^{MutualReco}(t-2) \times NorthSouth$	0.352*	
	(0.203)	
$SPS_{all}^{MutualReco}(t-2) \times SouthSouth$	-0.246*	
	(0.149)	
$SPS_{all}^{Harmo}(t-2) \times NorthNorth$		0.0682
		(0.0684)
$SPS_{all}^{Harmo}(t-2) \times NorthSouth$		-0.103*
		(0.0609)
$SPS_{all}^{Harmo}(t-2) \times SouthSouth$		-0.156*
		(0.0851)
$TotalDepth$	0.00347***	0.00427***
	(0.00132)	(0.00138)
Observations	526,034	526,034
R-squared	0.246	0.246
Origin-time FE	Yes	Yes
Destination-time FE	Yes	Yes
HS2 FE	Yes	Yes
pair FE	yes	yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.8: SPS lagged interaction with level of development

VARIABLES	ln(*quality*)			
	(1)	(2)	(3)	(4)
$TBT_{all}^{MutualReco}(t-2)$	-0.153**	-0.0669		
	(0.0678)	(0.0548)		
$TBT_{all}^{MutualReco}(t-2) \times LadderFullRange$	0.0190***			
	(0.00659)			
$TBT_{all}^{MutualReco}(t-2) \times LadderInterquartile$		0.0302**		
		(0.0133)		
$TBT_{all}^{Harmo}(t-2)$			-0.299***	0.0872*
			(0.0667)	(0.0472)
$TBT_{all}^{Harmo}(t-2) \times LadderFullRange$			0.0377***	
			(0.00613)	
$TBT_{all}^{Harmo}(t-2) \times LadderInterquartile$				-0.0225**
				(0.00983)
$LadderFullRange$	0.355***		0.353***	
	(0.00205)		(0.00206)	
$LadderInterquartile$		0.641***		0.645***
		(0.00314)		(0.00329)
$TotalDepth$	0.000361	0.000272	0.000561	0.000502
	(0.00114)	(0.00113)	(0.00115)	(0.00114)
Observations	2,489,024	2,489,024	2,489,024	2,489,024
R-squared	0.615	0.629	0.615	0.629
Origin-time FE	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.9: TBT lagged interaction with ladder length

VARIABLES	ln(*quality*)			
	(1)	(2)	(3)	(4)
$SPS_{all}^{MutualReco}(t-2)$	-0.252*	0.00679		
	(0.130)	(0.118)		
$SPS_{all}^{MutualReco}(t-2) \times LadderFullRange$	0.138***			
	(0.0354)			
$SPS_{all}^{MutualReco}(t-2) \times LadderInterquartile$		0.0256		
		(0.0468)		
$SPS_{all}^{Harmo}(t-2)$			-0.227***	-0.0220
			(0.0482)	(0.0397)
$SPS_{all}^{Harmo}(t-2) \times LadderFullRange$			0.0738***	
			(0.0128)	
$SPS_{all}^{Harmo}(t-2) \times LadderInterquartile$				0.0507***
				(0.0193)
$LadderFullRange$	0.278***		0.269***	
	(0.00530)		(0.00540)	
$LadderInterquartile$		0.492***		0.483***
		(0.00891)		(0.00950)
$TotalDepth$	0.00324***	0.00188	0.00345***	0.00219*
	(0.00121)	(0.00120)	(0.00126)	(0.00124)
Observations	513,656	513,656	513,656	513,656
R-squared	0.415	0.425	0.417	0.425
Origin-time FE	Yes	Yes	Yes	Yes
Destination-time FE	Yes	Yes	Yes	Yes
HS2 FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.10: SPS lagged interaction with ladder length

Appendix B: Derivation of the optimal TBT/SPS-related costs and productivity thresholds

B.1 Maximization problem under no recognition

In the no recognition scenario (NR), optimal qualities are chosen for each destination markets separately and if firms cannot eventually sustain the usual Melitz fixed costs to export, then dropping a market does not influence their quality choices for the remaining destination markets. The firm's profit maximization problem if export to each markets $(1, 2, ...k)$ and domestic market i is written:

$$\max \pi(f_{i1}, f_{i2}, ..., f_{ik}) = \sum_{j=1}^{k} \frac{\mu_j E_j}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{t_{ij} \tau_{ij} w_i}{\varphi \tilde{P}_j} \right)^{1-\sigma} f_{ij}^{\psi(\sigma-1)} - w_i \sum_{j=1}^{k} (f_{ij} + F_{ij}) \tag{B.1}$$

subject to

$$\forall j \in (1, ..., k), \quad f_{ij} > \underline{f}_j \tag{B.2}$$

The Lagrangian is defined as $L(f, \lambda) = \pi(f) - \sum_{j=1}^{k} \lambda_j (\underline{f}_j - f_{ij})$, where $f = (f_{i1}, f_{i2}, ..., f_{ik})$ and $\lambda = (\lambda_1, ..., \lambda_k)$.

B.1.1 Finding optimal qualities under NR

Maximum under constraints must satisfy the following equations:

- Interior solution $\frac{\partial L(f,\lambda)}{\partial f_{ij}} = \frac{\partial \pi(f)}{\partial f_{ij}} + \lambda_j = 0, \forall j \in (1, ..., k)$
- complementary slackness $\lambda \frac{\partial L(f,\lambda)}{\partial \lambda} = \lambda \left[\underline{f}_{ij} - f_{ij} \right] = 0$
- original constraint $\frac{\partial L(f,\lambda)}{\partial \lambda} = \underline{f}_j - f_{ij} \leq 0$
- $\lambda_{ij} \geq 0 \forall j \in (1, ..., k)$

The interior solutions verify:

$$\frac{\partial L(f,\lambda)}{\partial f_{ij}} = \mu_j E_j \frac{\psi(\sigma-1)}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j} \right)^{1-\sigma} f_{ij}^{\psi(\sigma-1)-1} - w_i + \lambda_j = 0 \qquad \text{(B.3)}$$

Which requires $\psi(\sigma-1)-1 < 0$ to have a maximum (i.e. the second order conditions are negative).

- If the constraint for market j does not bind: $\lambda_j = 0$ and therefore $\underline{f}_j < f_{ij}$

$$f_{ij}^{opt} = \left[\frac{w_i}{\mu_j E_j} \frac{\sigma}{\psi(\sigma-1)} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j} \right)^{\sigma-1} \right]^{\frac{1}{\psi(\sigma-1)-1}} \qquad \text{(B.4)}$$

- If the constraint binds, then $\lambda_j > 0$ and $\underline{f}_j = f_{ij}$

B.1.2 Finding productivity threshold under NR

The productivity thresholds are such that $\pi_j(f_{ij}^{opt}) > 0, \forall j$

- If $f_{ij}^{opt} = \underline{f}_j$

$$\begin{aligned}
\pi_j(\underline{f}_{ij}) = \frac{\mu_j E_j}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{1-\sigma}\underline{f}_j^{\psi(\sigma-1)} - w_i\left(\underline{f}_j + F_{ij}\right) > 0 \\
\varphi^{\sigma-1}\frac{\mu_j E_j}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\tilde{P}_j}\right)^{1-\sigma}\underline{f}_j^{\psi(\sigma-1)} - w_i\left(\underline{f}_j + F_{ij}\right) > 0 \\
\varphi^{\sigma-1} > \frac{w_i\left(\underline{f}_j + F_{ij}\right)}{\frac{\mu_j E_j}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\tilde{P}_j}\right)^{1-\sigma}\underline{f}_j^{\psi(\sigma-1)}}
\end{aligned} \tag{B.5}$$

Finally using $q = f^{\psi}$

$$\varphi_{ij}^{*,NR} = \underline{q}_j^{\frac{1-\psi(\sigma-1)}{\psi(\sigma-1)}}\left(1 + \frac{F_{ij}^{\psi}}{\underline{q}_j}\right)^{\frac{1}{\psi(\sigma-1)}}[\Gamma_{ij}]^{\frac{-1}{\sigma-1}} \tag{B.6}$$

Where $\Gamma_{ij} = \frac{\psi(\sigma-1)}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\tilde{P}_j}\right)^{1-\sigma}\frac{\mu_j E_j}{w_i t_{ij}}$

- if f_{ij}^{opt} as in (B.11)

$$
\begin{aligned}
&\Rightarrow \frac{\mu_j E_j}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{1-\sigma}\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{\psi(\sigma-1)}{\psi(\sigma-1)-1}} \\
&\quad > w_i\left(\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}}+F_{ij}\right) \\
&\Rightarrow \frac{w_i}{w_i}\frac{\psi(\sigma-1)}{\psi(\sigma-1)}\frac{\mu_j E_j}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{1-\sigma}\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{\psi(\sigma-1)}{\psi(\sigma-1)-1}} \\
&\quad > w_i\left(\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}}+F_{ij}\right) \\
&\Rightarrow \frac{w_i}{w_i}\frac{\psi(\sigma-1)}{\psi(\sigma-1)}\frac{\mu_j E_j}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{1-\sigma}\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{\psi(\sigma-1)}{\psi(\sigma-1)-1}} \\
&\quad > w_i\left(\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}}+F_{ij}\right) \\
&\Rightarrow \frac{w_i}{\psi(\sigma-1)}\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}} \\
&\quad > w_i\left(\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}}+F_{ij}\right) \\
&\Rightarrow w_i\frac{1-\psi(\sigma-1)}{\psi(\sigma-1)}\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\varphi\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}} > w_i F_{ij} \\
&\Rightarrow \varphi^{\frac{1-\sigma}{\psi(\sigma-1)-1}} > \frac{F_{ij}}{\frac{1-\psi(\sigma-1)}{\psi(\sigma-1)}\left[\frac{w_i}{\mu_j E_j}\frac{\sigma}{\psi(\sigma-1)}\left(\frac{\sigma}{\sigma-1}\frac{t_{ij}\tau_{ij}w_i}{\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}}}
\end{aligned}
\tag{B.7}
$$

Remark that the above threshold is bounded by the threshold obtained from the corner solution $f_{ij}^{opt} = \underline{f}_{ij}$, therefore the overall productivity threshold corresponds to the minimum of those two.

B.2 Maximization problem under full integration

Under full integration (NR or HR) the solutions for the optimal fixed costs are not separable anymore. Firms choose a unique f_i^{opt} that will apply domestically and to any markets part of the PTA. The trade policy change corresponds to the move from k inequality constraints to a unique inequality. While the decision to export to different markets were separable in the non-recognition case, in this context the choice of the unique f_i^{opt} is entangled with the decisions to export to specific set of markets. The problem could be solved computationally backwards. First fixing the number of exports market and then solving for optimal f, then discussing what happen for the marginal firm that cannot export to all k markets but would be better off exporting to only $k-1$ markets.

The profit maximization problem can be rewritten as:

$$\max \pi(f_i, \mathbb{1}_1, ..., \mathbb{1}_k) = f_i^{\psi(\sigma-1)} \sum_{j=1}^{k} \mathbb{1}_j \frac{\mu_j E_j}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j} \right)^{1-\sigma} - w_i f_i - w_i \sum_{j=1}^{k} \mathbb{1}_j F_{ij} \tag{B.8}$$

subject to

$$f_i > \underline{f} \tag{B.9}$$

Where $\underline{f}$ could be the maximum of all $\underline{f}_j$ or some other international standards.

And $\mathbb{1}_j$ are indicator variables $(0, 1)$ representing the decision to export to market j

The new Lagrangian is defined as $L(f_i, \lambda) = \pi(f_i) - \lambda(\underline{f} - f_i)$,

B.2.1 Finding optimal qualities under MR or HR

- Interior solution $\frac{\partial L(f_i,\lambda)}{\partial f_i} = \frac{\partial \pi(f_i)}{\partial f_i} + \lambda = 0$
- complementary slackness $\lambda \frac{\partial L(f_i,\lambda)}{\partial \lambda} = \lambda \left[\underline{f} - f_i\right] = 0$
- original constraint $\frac{\partial L(f_i,\lambda)}{\partial \lambda} = \underline{f} - f_i \leq 0$
- $\lambda \geq 0$

The interior solution if the firm enters k markets verifies:

$$\frac{\partial L(f, \lambda)}{\partial f_{ij}} = f_i^{\psi(\sigma-1)-1} \sum_{j=1}^{k} \mu_j E_j \frac{\psi(\sigma-1)}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j} \right)^{1-\sigma} - w_i + \lambda = 0 \quad \text{(B.10)}$$

- If the constraint does not bind: $\lambda = 0$ and therefore $\underline{f} < f_i$

$$f_{ij}^{opt} = \left[\sum_{j=1}^{k} \frac{w_i}{\mu_j E_j} \frac{\sigma}{\psi(\sigma-1)} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j} \right)^{\sigma-1} \right]^{\frac{1}{\psi(\sigma-1)-1}} \quad \text{(B.11)}$$

- If the constraint binds, then $\lambda > 0$ and $\underline{f} = f_i$

B.2.2 Finding productivity threshold under MR or HR

The productivity thresholds are such that $\pi(f^{opt}) > 0$

- $f_i^{opt} = \underline{f}$

$$\pi(\underline{f}_{ij}) = \underline{f}^{\psi(\sigma-1)} \sum_{j=1}^{k} \frac{\mu_j E_j}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j} \right)^{1-\sigma} - w_i \underline{f} - w_i \sum_{j=1}^{k} F_{ij} > 0$$

$$\varphi^{\sigma-1} > \frac{w_i \left(\underline{f} + \sum_{j=1}^{k} F_{ij} \right)}{\underline{f}^{\psi(\sigma-1)} \sum_{j=1}^{k} \frac{\mu_j E_j}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\tilde{P}_j} \right)^{1-\sigma}} \tag{B.12}$$

Even if we consider that countries that sign a PTA have similar domestic TBT/SPS regulations (i.e. $\underline{f}_j \sim \underline{f}$), the expression of exporting threshold has an ambiguous relationship with the number of destination markets. Both numerator and denominator increases with the number of destinations, making the overall change impossible to evaluate for regional PTAs (more than two countries) without computational method. For bilateral PTAs, the denominator still increases with full integration, but the numerator remains the same as the non recognition scenario (assuming $\underline{f}_j \sim \underline{f}$). Therefore, the exporting threshold defined by (B.12) shows that mutual recognition or harmonization of TBT/SPS measures increases the number of exporters at least for bilateral PTAs.

- if f_{ij}^{opt} as in (B.11)

$$
\begin{aligned}
&\Rightarrow \left[\sum_{j=1}^{k} \frac{w_i}{\mu_j E_j} \frac{\sigma}{\psi(\sigma-1)} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{\psi(\sigma-1)}{\psi(\sigma-1)-1}} \sum_{j=1}^{k} \frac{\mu_j E_j}{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j}\right)^{1-\sigma} \\
&\quad > w_i \left(\left[\sum_{j=1}^{k} \frac{w_i}{\mu_j E_j} \frac{\sigma}{\psi(\sigma-1)} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}} + \sum_{j=1}^{k} F_{ij}\right) \\
&\Rightarrow \frac{w_i}{\psi(\sigma-1)} \left[\sum_{j=1}^{k} \frac{w_i}{\mu_j E_j} \frac{\sigma}{\psi(\sigma-1)} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}} \\
&\quad > w_i \left(\left[\sum_{j=1}^{k} \frac{w_i}{\mu_j E_j} \frac{\sigma}{\psi(\sigma-1)} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}} + \sum_{j=1}^{k} F_{ij}\right) \\
&\Rightarrow w_i \frac{1-\psi(\sigma-1)}{\psi(\sigma-1)} \left[\sum_{j=1}^{k} \frac{w_i}{\mu_j E_j} \frac{\sigma}{\psi(\sigma-1)} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\varphi \tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}} > w_i \sum_{j=1}^{k} F_{ij}
\end{aligned}
\tag{B.13}
$$

$$
\Rightarrow (\varphi^*)^{\frac{1-\sigma}{\psi(\sigma-1)-1}} = \frac{\sum_{j=1}^{k} F_{ij}}{\frac{1-\psi(\sigma-1)}{\psi(\sigma-1)} \left[\sum_{j=1}^{k} \frac{w_i}{\mu_j E_j} \frac{\sigma}{\psi(\sigma-1)} \left(\frac{\sigma}{\sigma-1} \frac{t_{ij}\tau_{ij}w_i}{\tilde{P}_j}\right)^{\sigma-1}\right]^{\frac{1}{\psi(\sigma-1)-1}}} \tag{B.14}
$$

The resulting expression for the productivity threshold in the case of mutual recognition or harmonization shows that if a firm productivity falls just below this threshold it can always drop a market and select a smaller optimal quality. This up to the point where the optimal quality hits the minimum quality requirement applicable in the integrated market. Therefore, we can use (B.12)

as the minimum export threshold in the mutual recognition case.

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